1978

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INTERNATIONAL PACIFIC SALMON
FISHERIES COMMISSION

APPOINTED UNDER A CONVENTION
BETWEEN CANADA AND THE UNITED STATES FOR THE
PROTECTION, PRESERVATION AND EXTENSION OF
THE SOCKEYE AND PINK SALMON FISHERIES
IN THE FRASER RIVER SYSTEM

ANNUAL REPORT

1978

COMMISSIONERS

DONALD R. JOHNSON
WILLIAM G. SALETIC
GORDON SANDISON

W. R. HOURSTON
RICHARD A. SIMMONDS
ALVIN W. DIXON

NEW WESTMINSTER
CANADA
1979

INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION

MEMBERS AND PERIOD OF SERVICE SINCE THE INCEPTION OF THE COMMISSION IN 1937

CANADA

William A. Found	1937-1939
A. L. Hager	1937-1948
Senator Thomas Reid	1937-1967
A. J. Whitmore	1939-1966
	1968-1969
Olof Hanson	1948-1952
H. R. MacMillan, C.B.E., D.Sc.	1952-1956
F. D. Mathers	1956-1960
W. R. Hourston	1960-
Richard Nelson	1966-1976
Roderick Haig-Brown	1970-1976
Richard A. Simmonds	1976-
Alvin W. Dixon	1978-

UNITED STATES

Edward W. Allen	1937-1951
	1957-1957
B. M. Brennan	1937-1942
Charles E. Jackson	1937-1946
Fred J. Foster	1943-1947
Milo Moore	1946-1949
	1957-1961
Albert M. Day	1947-1954
Alvin Anderson	1949-1950
Robert J. Schoettler	1951-1957
Elton B. Jones	1951-1957
Arnie J. Suomela	1954-1961
DeWitt Gilbert	1957-1974
George C. Starlund	1961-1966
Clarence F. Pautzke	1961-1969
Thor C. Tollefson	1966-1975
Charles H. Meacham	1969-1970
Donald R. Johnson	1971-
William G. Saletic	1974-
Donald W. Moos	1975-1977
Gordon Sandison	1977-

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DIRECTOR — A. C. COOPER
ASSISTANT DIRECTOR — J. F. ROOS

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REPORT OF THE INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION FOR THE YEAR 1978

The 1978 Fraser River sockeye run of 9.5 million fish was the fourth largest on this cycle in over 80 years of records (Figure 1), based on catch records. Since 1950 this cycle (1910) has averaged 8.52 million sockeye each run, about 40% more than the minimum 6.1 million estimated average in the period 1894-1914 for the runs not affected by the Hell's Gate slide (Table 1).

Table 1. Average total runs of Fraser River sockeye, millions.

1910-1978	*cycle*	1911-1979	*cycle*	1912-1980	*cycle*	1913-1981	*cycle*
1894-1914	6.10	1895-1915	5.30	1896-1916	3.51	1897-1913	26.09
1918-1946	5.23	1919-1947	1.41	1920-1948	2.07	1917-1949	3.44
1950-1978	8.52	1951-1975	4.67	1952-1976	3.20	1953-1977	5.23

(Data 1915 to 1949 from Killick and Clemens, 1963. Data prior to 1915 from catch records and minimum escapement estimates.)[1]

The catch of Fraser River sockeye on this cycle has averaged 6.29 million since 1950, which is about 20% more than the average of 5.12 million in the period 1894-1914 (Table 2). This is the only cycle in which the cyclic abundance of sockeye now exceeds the historical abundance, although the 1911 and 1912 cycles have been restored to 80% or more of their historical abundance. Up to 1913 most of the sockeye runs were dominant on the 1913 cycle. This cycle is currently the second largest but the abundance of sockeye is only about one-fifth of the average in the period 1897-1913.

Table 2. Average annual catches of Fraser River sockeye, all waters, millions.

1910-1978	*cycle*	1911-1979	*cycle*	1912-1980	*cycle*	1913-1981	*cycle*
1894-1914	5.12	1895-1915	4.42	1896-1916	3.08	1897-1913	22.63
1918-1946	4.00	1919-1947	1.12	1920-1948	1.56	1917-1949	2.70
1950-1978	6.29	1951-1975	3.71	1952-1976	2.46	1953-1977	4.04

The development program for sockeye salmon recommended by the Commission in 1972 placed most of its emphasis on the expansion of existing runs on the 1913 cycle to utilize the rearing capability available in Quesnel, Francois, Stuart, Takla and Trembleur Lakes. It was estimated that these five lakes contained 73% of

[1]Killick, S. R. and W. A. Clemens. The Age, Sex Ratio and Size of Fraser River Sockeye, 1915 to 1960. Int. Pac. Salmon Fish. Comm. Bull. XIV. 1963.

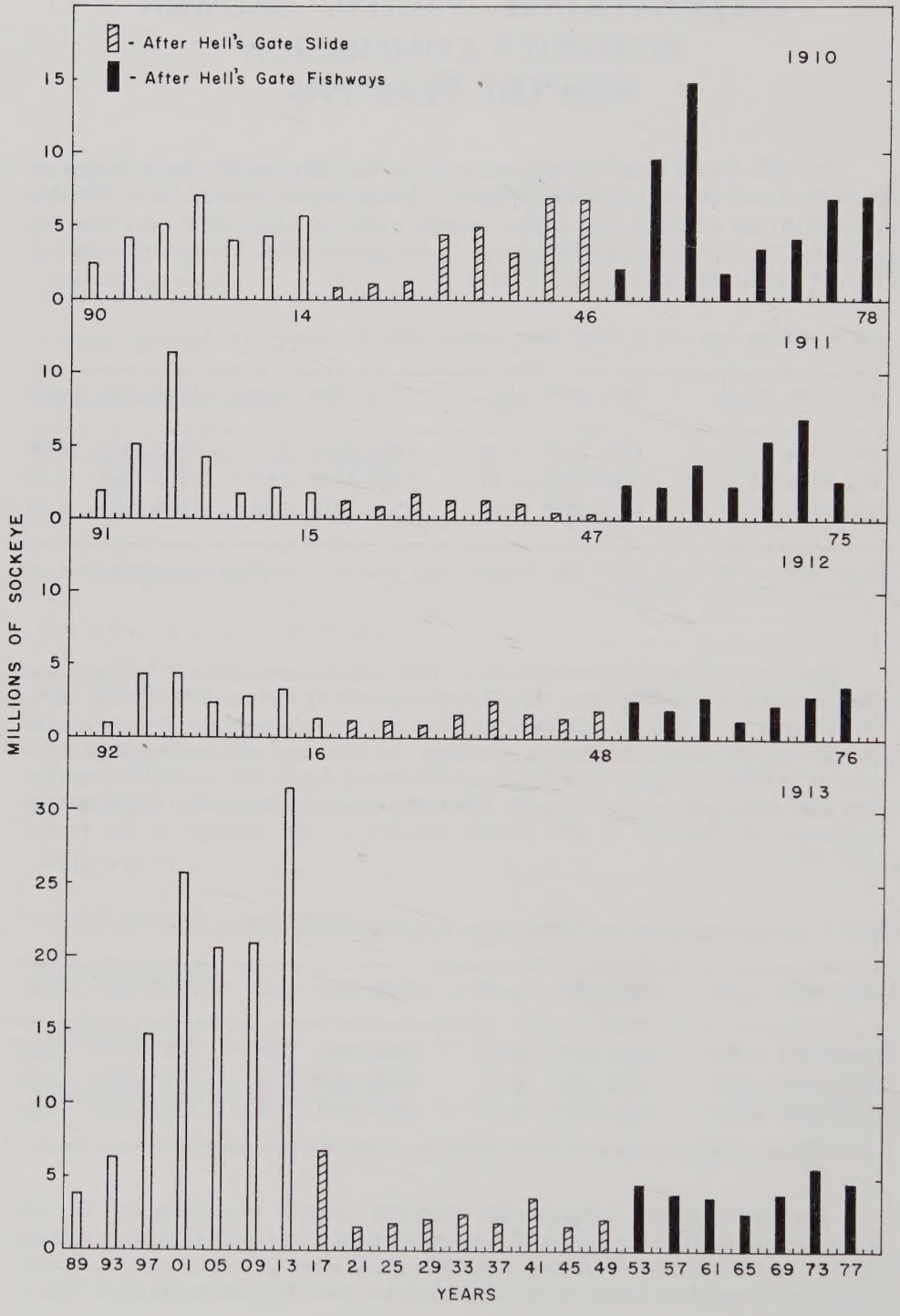

Figure 1. Catches of Fraser River sockeye, Convention Waters and Non-Convention Waters combined, by cycle years.

all the unutilized lake rearing capability for sockeye in the Fraser River system, and the spawning channels proposed for these lakes were estimated to be capable of producing an average catch of 5.4 million sockeye annually, or about 95% of the additional catch estimated for the entire development program. The purpose of this program was to provide the impetus to the stocks now rearing in these lakes to expand the total Fraser River sockeye production to historical abundance. However, recent growth in the sockeye runs to the Horsefly and Mitchell Rivers in the Quesnel Lake system (Table 3) suggest further evaluation of the need for the proposed spawning channels on the Horsefly River and McKinley Creek. These channels were recommended in 1972 because the spawning populations in Horsefly River selected the spawning grounds in the section of the river below the falls upstream from McKinley Creek, and these spawning grounds had a limited capacity far below known historical escapements and far below the rearing capability of Quesnel Lake. However, the increased escapement obtained in 1977 spread out over most of the large spawning grounds extending downstream to Quesnel Lake and there now is prospect of continued growth of the run to much greater abundance. Further, the recent growth in the runs to the Lower and Middle Shuswap River (Table 3) and the growth in subdominant cycles of a number of other runs, now suggests the possibility of further substantial growth in production from other natural spawning grounds.

Table 3. Growth in total runs of Quesnel Lake system and Shuswap River system sockeye stocks.

Return Year	*Quesnel Lake System*	*Return Year*	*Shuswap River System*
1953	463,000	1954	141,000
1957	604,000	1958	81,000
1961	989,000	1962	57,000
1965	1,196,000	1966	61,000
1969	1,643,000	1970	87,000
1973	1,627,000	1974	418,000
1977	2,154,000p	1978	722,000p

p — preliminary.

Early catch records from traps in United States Waters show that the bulk of the catch on the 1897-1913 cycle was made from runs migrating through those waters from about mid July to about the third week of August (Figure 2). This timing suggests that the runs to Horsefly, Chilko, Stellako, Late Stuart and the Shuswap Lake system, as well as the now extinct run to Upper Adams River, were the major contributors to these catches.

In the period 1894-1913 the catch of Fraser sockeye averaged 9.0 million annually. Catches dropped to 2.4 million annually in the period 1914-1949, and have increased to 4.26 million annually from 1951 to 1978. To restore the catches to the historical level an additional 4.74 million annual catch is required, and to produce this catch an additional 0.75 million female sockeye spawners annually would be needed above the average for the years 1947-1974, or an increase of 3.0 million female spawners total for the four cycle years. Examination of data on spawning ground areas

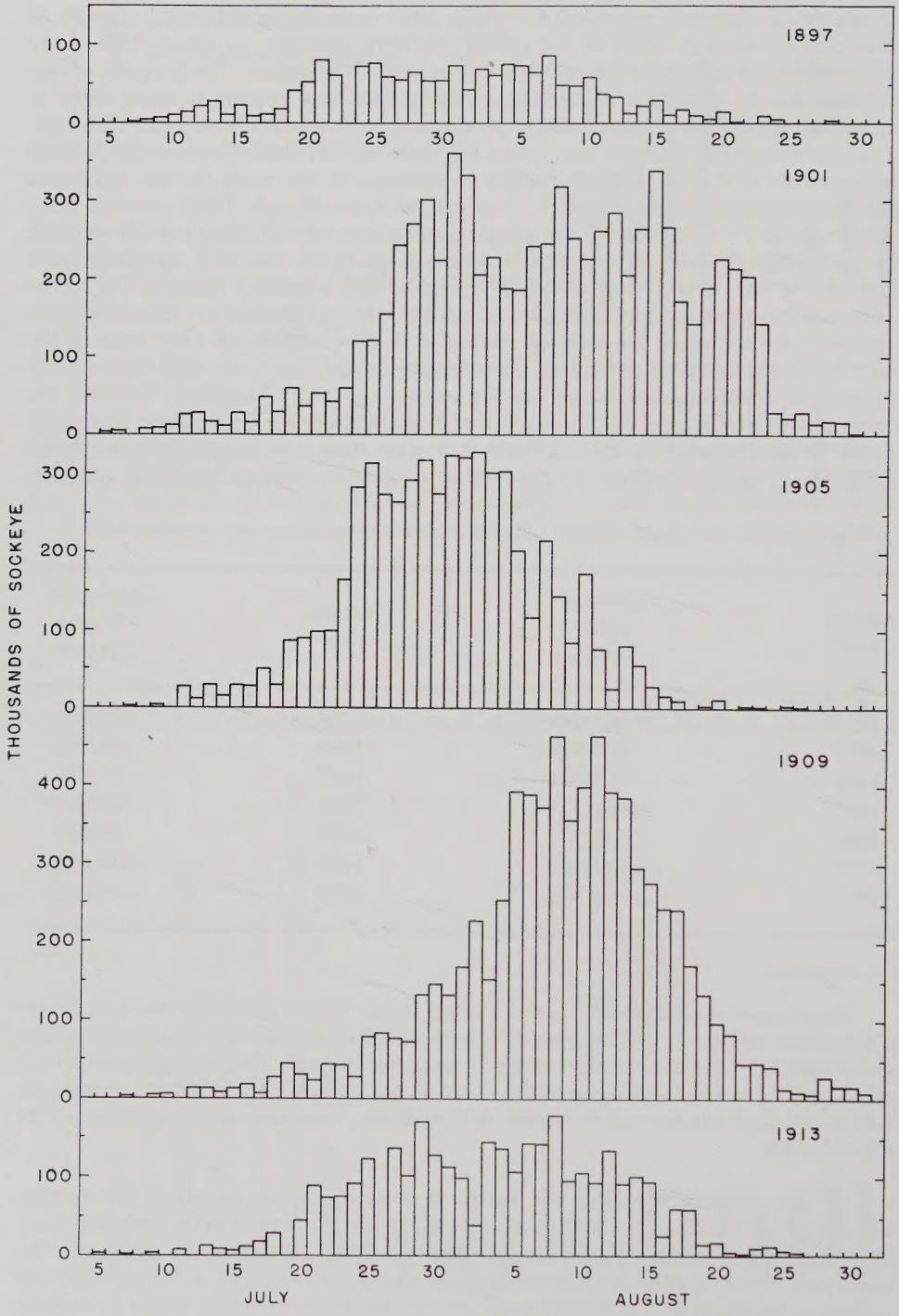

Figure 2. Timing of Fraser River sockeye catches in Salmon Banks-Point Roberts area from selected trap catches on the dominant cycle prior to the Hell's Gate obstruction.

and, where available, optimum number of spawners, suggests there is unused capacity at known spawning grounds to accommodate close to this increase in sockeye spawners on the dominant cycle plus one or more subdominant cycles in the runs that were the major contributors to the historical catches (Table 4).

Table 4. Potential increase in female sockeye spawners.

Run	*Estimated Capacity*	*Average * 1947-74*	*Potential Increase*
1910 Cycle			
Chilko	80,000	58,419	21,581
Lower Shuswap	500,000	17,172	482,828
Horsefly	100,000	949	99,051
Early Nadina	167,000	317	166,683
1911 Cycle			
Stellako	85,000	43,767	41,233
Tachie	40,000	692	39,308
Middle	50,000	1,066	48,934
Adams	250,000	137,542	112,458
Lower Shuswap	50,000	1,521	48,479
Early Nadina	167,000	372	166,628
1912 Cycle			
Stellako	85,000	18,393	66,607
Early Nadina	167,000	591	166,409
1913 Cycle			
Horsefly	1,150,000	132,038	1,017,962
Early Nadina	167,000	8,535	158,465
	3,058,000	421,374	2,636,626

*Brood spawners for the catches of 1951-78.

The spawning grounds of the Quesnel Lake system, mainly in the Horsefly River, have the largest potential for increase of any of the spawning grounds. The expansion of this run to the level indicated in the table would mean about twice as many spawners as previously estimated from lake rearing capacity based on plankton abundance. However, records indicate more than 4 million spawners entered Quesnel Lake in 1909, so 2 million spawners is not an unreasonable expectation. Furthermore, previous estimates of lake rearing capacity based on plankton abundance were considered to be minimum based on known occurrences, but this does not preclude rearing of larger populations. The optimum level of utilization of Quesnel Lake has yet to be established. The growth of a subdominant Horsefly run in recent years, with 3735 female spawners in 1978, indicates the probability of a substantial subdominant run also. With continuation of the present expansion of these runs to spawning areas not used since 1909, it is possible the proposed spawning channels on the Horsefly River may not be needed to reach historical production levels, although they might still be justified on the basis of further expansion of the stocks.

The spawning grounds of the Lower Shuswap River represent the second largest potential for increase in numbers of spawners. The expansion of this run to the level indicated in the table, in conjunction with the existing Adams River run, would give about a 50% increase in the rearing utilization of Shuswap Lake over the present average, and there is indication that this would be near or possibly above the optimum level of utilization. The growth of a subdominant run to the Lower Shuswap River, with 6094 female spawners in 1975, provides further potential for production from these spawning grounds.

Data for the Adams and Chilko River runs show that at least one subdominant run could be increased for each of these stocks, and data for the Stellako run show that two subdominant runs could be increased. The Late Stuart runs that spawn in Middle River and Tachie River could also be increased on one or more subdominant runs because of the low utilization of the rearing capacity of Stuart Lake.

It has been estimated that the Early Stuart runs in 1973 and 1977 were the largest this stock ever produced. The early catch records (Figure 2) do not suggest a large contribution by this stock in the historical catches. The 1973 and 1977 runs appear to represent almost the optimum level of production from the existing spawning grounds used by the stock, and if this is the case, only a small part of the rearing capacity of Stuart, Trembleur and Takla Lakes will be utilized by these stocks. These lakes therefore represent a large potential for increasing the Fraser sockeye runs, but spawning channels as proposed by the Commission would be needed to develop this potential. The spawning grounds used by the Early Nadina run could support full capacity of spawners on all four cycles, since they still would utilize only about one-fifth of the minimum estimated rearing capacity of Francois Lake. The spawning channel proposed by the Commission for the Early Nadina run would provide utilization of the balance of the rearing capacity. The Early Stuart and Nadina runs are among the first to migrate up the Fraser River each season and in recent years have been subject to intense fishing effort along the river migration route, with an average of 47% of the Early Stuart and 30% of the Nadina gross escapements being caught. It is becoming increasingly difficult to obtain the escapements needed for optimum production, and some augmentation of fry production may be necessary to maintain the existing runs.

On the basis of area of spawning grounds, the Upper Adams River could support perhaps as many as 1 million female sockeye spawners. This would be about 3 times more than the previously estimated rearing capacity of Adams Lake and perhaps would be more than optimum. In any event, there is substantial potential at this spawning ground. This stock was one of the main contributors to the historical catches but there is no residual left. Attempts to establish a new run so far have not been successful, although small returns have been obtained. The egg incubation station proposed by the Commission as part of the Development Program would provide a substantial base upon which to rebuild a run to Upper Adams River.

It is not possible to foresee how quickly the expansion of the runs listed in Table 4 could be accomplished. In some cases it may not be easy to obtain the increased escapements indicated because of requirements for management of other races. Much depends on taking advantage of regulatory opportunities. In the period 1975-78 the number of female spawners has increased to 752,828 and the estimated capacity has already been reached on the subdominant runs to Chilko and Stellako Rivers. The rate of growth of the Horsefly and Shuswap Rivers stocks will be the principal determining

factor, and regulatory measures must ensure increasing numbers of spawners for these runs. The continuing decline in the Early Nadina run must be corrected and a replacement for the Upper Adams River must be found. These will be high priority management objectives for future cycles of these sockeye runs.

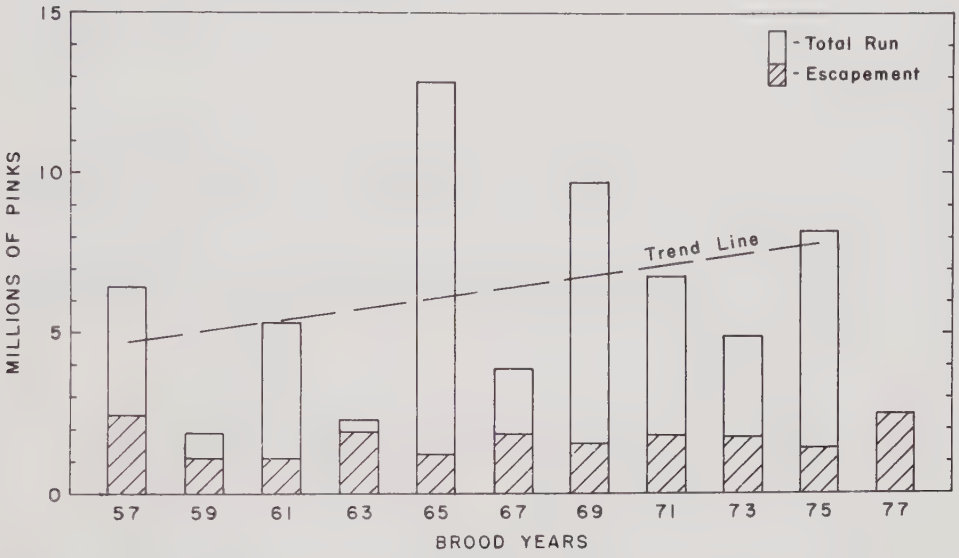

Figure 3. Fraser River pink salmon total runs and escapements, by brood years.

Although production of Fraser River pink salmon has fluctuated widely since the Commission was given responsibility for management starting in 1957, the trend of production shows an increase of 343,700 fish per cycle between the 1957 and 1975 brood years (Figure 3). The trend in number of spawners shows a small decline between the 1957 and 1975 brood years. However, there has been a change in the distribution of spawners, with a substantial decline in the number spawning downstream from Hell's Gate and a substantial increase in the number spawning above Hell's Gate (Figure 4). Accompanying this change there has been an increasing trend of 0.81% per cycle in freshwater survival rate and a slight decreasing trend of 0.04% per cycle in marine survival rate. These changes strongly suggest a beneficial effect from the increasing use of spawning grounds upstream from Hell's Gate, a result that is consistent with available evidence concerning historical production of pink salmon. The index of abundance used by Rounsefell and Kelez (1938) showed a decline in abundance after 1913 to about 24% of the abundance in the years 1907 to 1913, suggesting that the spawning grounds above Hell's Gate were responsible for perhaps three-quarters of the abundance up to 1913. "Countless millions" of pink salmon spawned in Seton Creek and in the Thompson and Nicola Rivers prior to 1913, but no pinks reached these spawning grounds after 1913 until after completion of the fishways at Hell's Gate. Since 1945, pink salmon have returned to these rivers and the number of spawners has grown to 1.4 million in 1977, but still with very few in the Nicola River. On the basis of estimated spawning area available, the spawning grounds above Hell's Gate could accommodate between 4 and 7 million spawners,

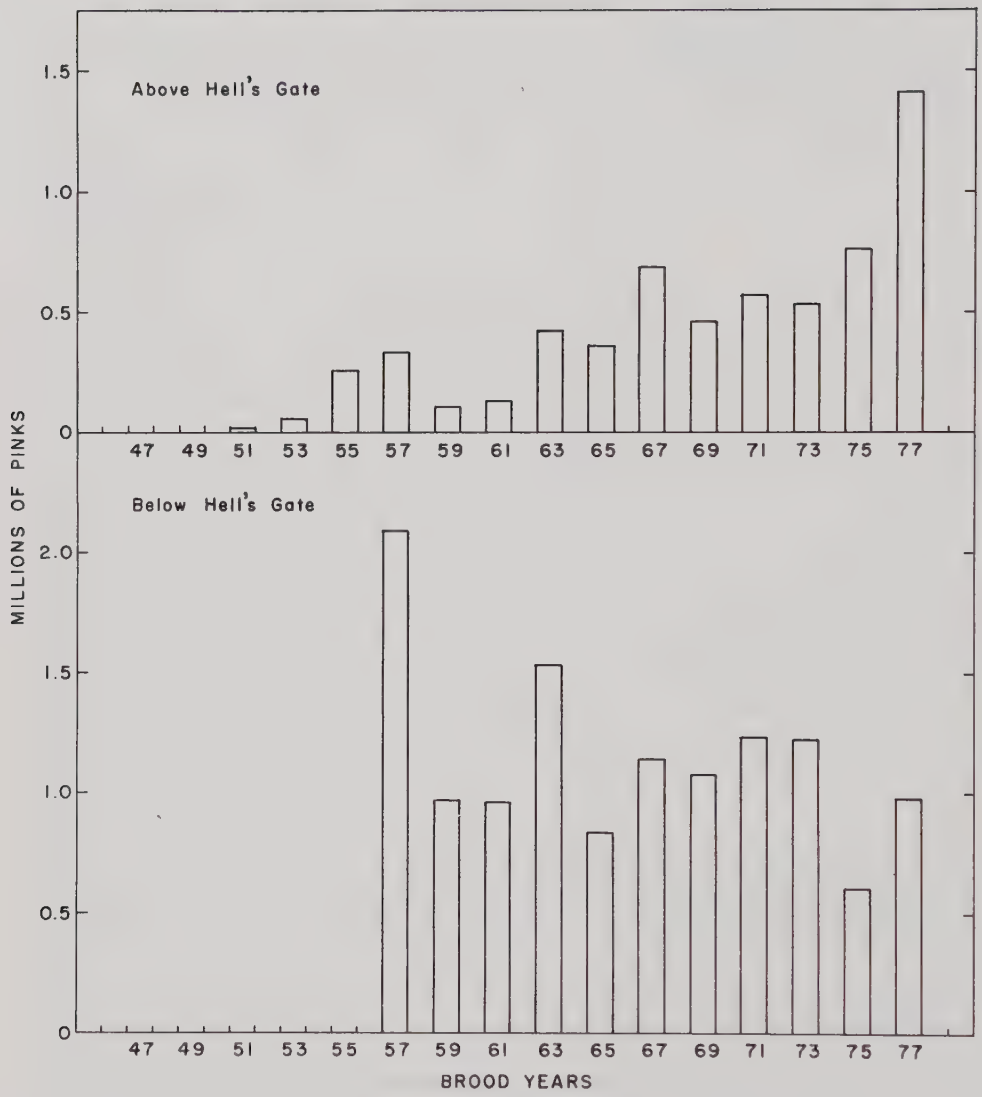

Figure 4. Fraser River Early run pink salmon spawners above and below Hell's Gate.

depending on the extent of use of the Nicola River. It has been demonstrated amply that pinks will colonize unused spawning grounds, and the limit of expansion of the stocks can only be determined by increasing the escapements. It will be a management objective to provide increasing numbers of Early run pink salmon each cycle until the optimum number can be determined. The Development Program recommended by the Commission in 1972 included channels on the Harrison and Chilliwack Rivers for the stocks of Late run pink salmon that utilize spawning grounds in these rivers. These proposals were based on the need to compensate for adverse spawning environment in parts of these rivers and this situation has not changed.

It seems obvious from the foregoing that there is a need for increased escapements of both sockeye and pink salmon to increase the abundance of these stocks, and thereby ultimately provide more fish for harvest. However, there will be need for selectively more restrictive regulations for possibly several life cycles for each species before the benefits will be realized, and this will require participation by *all* fisheries in measures needed to obtain the escapements.

COMMISSION MEETINGS

The International Pacific Salmon Fisheries Commission held sixteen formal and seventeen telephone meetings during 1978 with the approved minutes of the meetings being submitted to the Governments of Canada and the United States.

Mr. Alvin W. Dixon was appointed to the Commission early in 1978 representing Canada. At the end of 1978, the Commission membership was as follows:

United States	*Canada*
Donald R. Johnson	W. R. Hourston
William G. Saletic	Richard A. Simmonds
Gordon Sandison	Alvin W. Dixon

On April 28 the Commission approved the appointment of Mr. Tom Philpott as a member of the Advisory Committee representing United States Reef Net Fishermen. At the June 15 meeting the Commission approved the appointment of Mr. John Brajcich to the Advisory Committee for his second term representing Canadian Purse Seine Fishermen. At the end of 1978 the membership of the Advisory Committee was as follows:

United States	*Canada*
W. Green Purse Seine Fishermen	J. Brajcich Purse Seine Fishermen
D. Franett Salmon Processors	J. O'Connor Salmon Processors
R. Christensen Gill Net Fishermen	F. Nishii Gill Net Fishermen
T. Philpott Reef Net Fishermen	N. Carr Purse Seine Crew Members
G. Simmons Troll Fishermen	M. Guns Troll Fishermen
E. Engman Sport Fishermen	H. English Sport Fishermen

The first meeting of 1978 was held March 3 with Mr. W. R. Hourston serving as Chairman and Mr. Gordon Sandison as Vice-Chairman and Secretary. The Commission met with the Advisory Committee regarding the tentative

recommendations for regulatory control of the 1978 sockeye salmon fishery in Convention Waters, as submitted to the Committee by the Commission on December 9, 1977. The Commission agreed to delay any decision on the regulatory matters raised by the Advisory Committee until such time as the Commission could act on the regulations. The budget for fiscal year 1979-80 was approved by the Commission.

On April 28, after certain revisions, the Commission approved the 1978 recommended regulations for submission to the two national governments. The draft of the 1977 Annual Report was approved. A revised budget for fiscal year 1978-79 was approved by the Commission.

The Commission met on June 15 and was advised of correspondence received from the United States Government approving the Commission's regulations for the 1978 sockeye salmon fishery in United States Convention Waters, with the exception of certain United States Indians. The Commission reviewed its recommended restrictions to the Indian Food Fishery during the time of the Early Stuart sockeye run. The Chairman reported that the Commission recommendations would not be implemented by the Fisheries Service because of a commitment to the Indians that they would not be restricted if there was any commercial fishery on the salmon stock concerned. The Commission did not consider a change in its recommendations would be advisable.

During the period July 7 to October 6 inclusive, the Commission held eleven formal and seventeen telephone meetings for adjustment of fishing regulations to achieve the desired escapement and, as nearly as practicable, equitable division of the allowable catch of Fraser River sockeye salmon.

On July 21 the Commission sent letters to both national governments objecting to the actions of the United States authorities providing multiple regulatory authority in United States Convention Waters contrary to provisions of the Convention. On August 15 the Commission approved a letter to the Minister of Fisheries for Canada protesting the selective enforcement of the Commission's recommendation and emergency order of August 4 regarding Indian fishery closures on Early Stuart and Chilko River sockeye runs. On September 1 the Commission sent a letter to the Minister of Fisheries bringing to his attention the Canada Fisheries Service regulation pertaining to troll fishing for sockeye in Area 21. Since Area 21 is within Convention Waters, it was stated the regulating of fishing for sockeye in these waters is the responsibility of the Commission. On October 17 the Commission, accompanied by members of the Advisory Committee, inspected the sockeye spawning in the Adams River.

The Commission met on December 1 to review the Annual Meeting presentation. The sixteenth and final formal meeting of the year was held on December 8 in Bellingham, Washington, when the Commission held its Annual Meeting with its Advisory Committee and approximately 350 representatives of industry, government and press. A review of events during the sockeye season was presented by the Chairman. The catch and escapement statistics for 1978 were given by the staff. The Director reviewed the recovery of Fraser River sockeye and pink salmon stocks since completion of the Hell's Gate fishways and drew attention to the prospects for continued growth from a number of major spawning areas. Prospects for 1979 fishing season were reviewed and tentative regulations for the 1979 fishery were proposed for consideration by industry and their representatives on the Commission's Advisory Committee.

1978 REGULATIONS

Recommendations for regulations governing the 1978 sockeye salmon fishery in Convention Waters were adopted at a meeting of the Commission held on April 28, 1978 and were submitted to the two national governments for approval on May 3, 1978. The recommendations for Canadian Convention Waters were implemented during the fishing season under the Fisheries Act, Pacific Commercial Salmon Fishery Regulations. On June 5, 1978 the United States Government informed the Commission regarding its recommended 1978 regulations as follows: "The United States Government has approved the recommended regulations except as to United States Indians who are entitled to exercise fishing rights by virtue of treaties with the United States in U.S. Convention waters and are fishing in accordance with Federal regulations providing for the exercise of such fishing rights." The National Marine Fisheries Service was designated as the enforcing agency in cooperation with other federal agencies.

The recommendations of the Commission were as follows:

Canadian Convention Waters

"The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation and extension of the Sockeye Salmon Fisheries of the Fraser River System, signed at Washington on the 26th day of May, 1930, as amended by the Pink Salmon Protocol signed at Ottawa on the 28th day of December, 1956, hereby recommends that, in the interests of such fisheries, the following Fraser River Sockeye and Pink Salmon Fishery Regulations for the season of 1978 be adopted by Order-in-Council pursuant to Section 34 of the Fisheries Act, namely:

1. (1) No person shall fish for sockeye or pink salmon in the waters of the southerly portion of District No. 3 in that portion of Area 20 lying westerly of a line drawn true south from Sheringham Point Lighthouse to the International Boundary with nets from the 25th day of June, 1978 to the 29th day of July, 1978, both dates inclusive.

(2) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with purse seines from the 30th day of July, 1978 to the 9th day of September, 1978, both dates inclusive, except from half past six o'clock in the forenoon to half past six o'clock in the afternoon of Monday and Tuesday of each week.

(3) No person shall fish for sockeye or pink salmon in the waters described in subsection (1) of this section with gill nets from the 30th day of July, 1978 to the 9th day of September, 1978, both dates inclusive, except from half past six o'clock in the afternoon of Sunday to half past six o'clock in the forenoon of Monday and from half past six o'clock in the afternoon of Monday to half past six o'clock in the forenoon of Tuesday of each week.

(4) No person shall troll commercially for sockeye or pink salmon in the waters described in subsection (1) of this section from the 30th day of July, 1978 to the 9th day of September, 1978, both dates inclusive, except at times that net fishing may be permitted within that area.

2. No person shall fish for sockeye or pink salmon with nets in the waters of the southerly portion of District No. 3 embraced in Areas 17 and 18:

(1) From the 25th day of June, 1978 to the 8th day of July, 1978, both dates inclusive; and

(2) From the 9th day of July, 1978 to the 22nd day of July, 1978, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week; and

(3) From the 23rd day of July, 1978 to the 5th day of August, 1978, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Wednesday of each week; and

(4) From the 6th day of August, 1978 to the 19th day of August, 1978, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week; and

(5) From the 20th day of August, 1978 to the 16th day of September, 1978, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week, in the waters lying westerly of a straight line drawn from Thrasher Rock Light to Law Point on Gabriola Island, thence along the easterly shoreline of Gabriola Island to Josef Point, thence in a straight line to Cordero Point on Valdez Island and along the easterly shoreline of Valdez Island to Vernaci Point, thence in a straight line to Race Point on Galiano Island and along the easterly shoreline of Galiano Island to Burrill Point, thence in a straight line to Georgina Point on Mayne Island, thence along the easterly shoreline of Mayne Island to Campbell Point, thence in a straight line to Winter Point on Saturna Island, thence along the easterly shoreline of Saturna Island to East Point, thence due south in a straight line to the International Boundary; and

(6) From the 17th day of September, 1978 to the 30th day of September, 1978, both dates inclusive.

3. No person shall fish for sockeye or pink salmon with gill nets in the Convention Waters portion of District No. 1:

(1) From the 25th day of June, 1978 to the 8th day of July, 1978, both dates inclusive, except for those sockeye or pink salmon taken in gill nets having mesh of net less than 8 inches extension measure as authorized for the taking of chinook salmon by the Regional Director for British Columbia, Fisheries and Marine Service, Department of the Environment, pursuant to the provisions of the Pacific Commercial Salmon Fishery Regulations; and

(2) From the 9th day of July, 1978 to the 22nd day of July, 1978, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week; and

(3) From the 23rd day of July, 1978 to the 5th day of August, 1978, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Wednesday of each week; and

(4) From the 6th day of August, 1978 to the 26th day of August, 1978, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week; and

(5) From the 27th day of August, 1978 to the 9th day of September, 1978, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday of each week, in the following described waters:

(a) The Fraser River upstream to the Canadian Pacific Railway Bridge at Mission City:

(i) In the Main Arm upstream from a straight line projected north and south magnetic through Woodwards Training Wall West Light near Steveston; and

(ii) In Canoe Pass upstream from a line projected north and south magnetic through Brunswick Cannery; and

(iii) In the North Arm upstream from Oak Street Bridge; and

(b) Those waters lying westerly of a line projected from Point Grey to the westerly end of the North Arm Jetty, thence to Sand Heads Light, thence to Canoe Pass Buoy, thence to a light on the westerly end of Tsawwassen Causeway and thence to where a straight line projected through Point Roberts Light intersects the International Boundary; and

(6) From the 10th day of September, 1978 to the 16th day of September, 1978, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday in those waters described in subsection (5) paragraph (b) of this section; and

(7) From the 17th day of September, 1978 to the 30th day of September, 1978, both dates inclusive; and

(8) From the 1st day of October, 1978 to the 7th day of October, 1978, both dates inclusive, except from eight o'clock in the forenoon of Monday to eight o'clock in the forenoon of Tuesday.

4. No person shall troll commercially for sockeye or pink salmon in those portions of the waters described in sections 2 and 3 lying easterly of a line from Reception Point to Orlebar Point on Gabriola Island, thence along the easterly shoreline of Gabriola Island to Josef Point, thence in a straight line to Cordero Point on Valdez Island and along the easterly shoreline of Valdez Island to Vernaci Point, thence in a straight line to Race Point on Galiano Island and along the easterly shoreline of Galiano Island to Burrill Point, thence in a straight line to Georgina Point on Mayne Island, thence along the easterly shoreline of Mayne Island to Campbell Point, thence in a straight line to Winter Point on Saturna Island, thence along the easterly

shoreline of Saturna Island to East Point, thence due south in a straight line to the International Bounday, from the 13th day of August, 1978 to the 23rd day of September, 1978, both dates inclusive, except at the times and locations that net fishing may be permitted within that area.

5. No person shall troll commercially for sockeye or pink salmon in those portions of the waters described in sections 2 and 3 lying east and south of a straight line projected from Gower Point at the westerly entrance to Howe Sound to Thrasher Rock Light, thence in a straight line to Salamanca Point on the southerly end of Galiano Island, thence in a straight line to East Point on Saturna Island, thence due south in a straight line to the International Boundary, from the 24th day of September, 1978 to the 30th day of September, 1978, both dates inclusive, except at the times and locations that net fishing may be permitted within that area.

All times hereinbefore mentioned shall be Pacific Daylight Saving Time."

United States Convention Waters

"The International Pacific Salmon Fisheries Commission appointed pursuant to the Convention between Canada and the United States of America for the protection, preservation and extension of the Sockeye Salmon Fisheries of the Fraser River System, signed at Washington on the 26th day of May, 1930, as amended by the Pink Salmon Protocol signed at Ottawa on the 28th day of December, 1956, hereby recommends to the United States Government that regulations to the following effect, in the interests of such fisheries, be adopted for the year 1978, and that an approved copy of said regulations be forwarded to the Director of Fisheries of the State of Washington for implementation by virtue of authority in him vested by Section 6 of Chapter 112 of the Laws of the State of Washington of 1949, namely:

1. No person shall fish for sockeye or pink salmon with nets in Convention Waters of the United States of America from the 25th day of June, 1978 to the 15th day of July, 1978, both dates inclusive.

2. (1) No person shall fish for sockeye or pink salmon with purse seines in the Convention Waters of the United States of America lying westerly of a straight line drawn from Angeles Point in the State of Washington across Race Rocks to William Head in the Province of British Columbia:

(a) From the 16th day of July, 1978 to the 12th day of August, 1978, both dates inclusive, except from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday and Tuesday of each week; and

(b) From the 13th day of August, 1978 to the 9th day of September, 1978, both dates inclusive, except from five o'clock in the forenoon to nine o'clock in the afternoon of Monday and Tuesday of each week.

(2) No person shall fish for sockeye or pink salmon with gill nets in the waters described in subsection (1) of this section:

(a) From the 16th day of July, 1978 to the 22nd day of July, 1978, and from the 30th day of July, 1978 to the 5th day August, 1978, all dates inclusive, except from seven o'clock in the afternoon of Sunday to half past nine o'clock in the forenoon of Monday and from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday of each week; and

(b) From the 23rd day of July, 1978 to the 29th day of July, 1978, and from the 6th day of August, 1978 to the 12th day of August, 1978, all dates inclusive, except from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday and from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday of each week; and

(c) From the 13th day of August, 1978 to the 19th day of August, 1978, and from the 27th day of August, 1978 to the 2nd day of September, 1978, all dates inclusive, except from six o'clock in the afternoon of Sunday to nine o'clock in the forenoon of Monday and from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday of each week; and

(d) From the 20th day of August, 1978 to the 26th day of August, 1978, and from the 3rd day of September, 1978 to the 9th day of September, 1978, all dates inclusive, except from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday and from six o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday of each week.

(3) No person shall fish for sockeye or pink salmon with commercial trolling gear in the waters described in subsection (1) of this section from the 16th day of July, 1978 to the 9th day of September, 1978, both dates

inclusive, except from Monday through Friday of each week on those days when purse seine fishing is permitted within that area.

3. (1) No person shall fish for sockeye or pink salmon with purse seines in the Convention Waters of the United States of America lying easterly of a straight line drawn from Angeles Point in the State of Washington across Race Rocks to William Head in the Province of British Columbia:

(a) From the 16th day of July, 1978 to the 12th day of August, 1978, both dates inclusive, except from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday and Tuesday of each week; and

(b) From the 13th day of August, 1978 to the 9th day of September, 1978, both dates inclusive, except from five o'clock in the forenoon to nine o'clock in the afternoon of Monday and Tuesday of each week.

(2) No person shall fish for sockeye or pink salmon with reef nets in the waters described in subsection (1) of this section:

(a) From the 16th day of July, 1978 to the 22nd day of July, 1978, and from the 30th day of July, 1978 to the 5th day of August, 1978, all dates inclusive, except from seven o'clock in the forenoon to half past nine o'clock in the afternoon of Sunday and from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday of each week; and

(b) From 23rd day of July, 1978 to the 29th day of July, 1978, and from the 6th day of August, 1978 to the 12th day of August, 1978, all dates inclusive, except from half past ten o'clock in the forenoon to half past nine o'clock in the afternoon of Sunday and from five o'clock in the forenoon to half past nine o'clock in the afternoon of Monday of each week; and

(c) From the 13th day of August, 1978 to the 19th day of August, 1978, and from the 27th day of August, 1978 to the 2nd day of September, 1978, all dates inclusive, except from seven o'clock in the forenoon to nine o'clock in the afternoon of Sunday and from five o'clock in the forenoon to nine o'clock in the afternoon of Monday of each week; and

(d) From the 20th day of August, 1978 to the 26th day of August, 1978, and from the 3rd day of September, 1978 to the 9th day of September, 1978, all dates inclusive, except from half past ten o'clock in the forenoon to nine o'clock in the afternoon of Sunday and from five o'clock in the forenoon to nine o'clock in the afternoon of Monday of each week.

(3) No person shall fish for sockeye or pink salmon with gill nets in the waters described in subsection (1) of this section:

(a) From the 16th day of July, 1978 to the 22nd day of July, 1978, and from the 30th day of July, 1978 to the 5th day of August, 1978, all dates inclusive, except from seven o'clock in the afternoon of Sunday to half past nine o'clock in the forenoon of Monday and from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday of each week; and

(b) From the 23rd day of July, 1978 to the 29th day of July, 1978, and from the 6th day of August, 1978 to the 12th day of August, 1978, all dates inclusive, except from seven o'clock in the afternoon of Monday to half past nine o'clock in the forenoon of Tuesday and from seven o'clock in the afternoon of Tuesday to half past nine o'clock in the forenoon of Wednesday of each week; and

(c) From the 13th day of August, 1978 to the 19th day of August, 1978, and from the 27th day of August, 1978 to the 2nd day of September, 1978, all dates inclusive, except from six o'clock in the afternoon of Sunday to nine o'clock in the forenoon of Monday and from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday of each week; and

(d) From the 20th day of August, 1978 to the 26th day of August, 1978, and from the 3rd day of September, 1978 to the 9th day of September, 1978, all dates inclusive, except from six o'clock in the afternoon of Monday to nine o'clock in the forenoon of Tuesday and from six o'clock in the afternoon of Tuesday to nine o'clock in the forenoon of Wednesday of each week.

4. (1) No person shall fish for sockeye or pink salmon with nets in that portion of the waters described in subsection (1) of section 3 lying northerly and westerly of a straight line drawn from Iwersen's Dock on Point Roberts in the State of Washington to Georgina Point Light at the entrance to Active Pass in the Province of British Columbia from the 27th day of August, 1978 to the 2nd day of September, 1978, and from the 24th day of September, 1978 to the 30th day of September, 1978, all dates inclusive.

(2) No person shall fish for sockeye or pink salmon with nets in that portion of the waters described in subsection (1) of section 3 lying westerly of a straight line drawn true south from the southeast tip of Point Roberts in the State of Washington (otherwise known as Lily Point) to the International Boundary from the 3rd day of September, 1978 to the 23rd day of September, 1978, both dates inclusive.

5. The foregoing recommended regulations shall not apply to the following United States Convention Waters:

(1) State Fishing Area 7B including Hale Passage and Bellingham Bay and all other Convention Waters of Area 7B lying easterly and inside of a line projected from Carter Point on Lummi Island to the most northerly tip of Vendovi Island, thence to Clark Point on Guemes Island following the shoreline to Southeast Point on Guemes Island, thence to March Point on Fidalgo Island, and

(2) State Fishing Areas 6B and 7C, and

(3) Preserves previously established by the Director of Fisheries of the State of Washington for the protection of other species of food fish.

All times hereinbefore mentioned shall be Pacific Daylight Saving Time."

Emergency Orders

In order to provide for adequate racial escapement of Fraser River sockeye salmon and for an equitable share of the season's catch by fishermen of the United States and Canada, the approved regulations as detailed above were later adjusted by the Commission as follows:

July 7, 1978 — In order to secure escapement of Early Stuart sockeye, the Commission cancelled the scheduled opening in Areas 17, 18 and District No. 1 of Canadian Convention Waters for the week commencing July 9.

July 28, 1978 — In the interest of obtaining additional escapement of early summer sockeye runs, the Commission approved the following regulatory changes for the week commencing July 30: 1. That Area 20 of Canadian Convention Waters scheduled opening be delayed 24 hours. 2. That the scheduled opening in United States Convention Waters be delayed 24 hours and reduced to one day of fishing. 3. That Areas 17, 18 and District No. 1 of Canadian Convention Waters scheduled opening be delayed 24 hours.

August 1, 1978 — In order to secure additional escapement of early summer races, the Commission approved a 24-hour reduction of fishing time in Areas 17, 18 and District No. 1 of Canadian Convention Waters to 24 hours closing at 8:00 a.m. August 2.

August 4, 1978 — In the interest of securing escapement of early summer sockeye runs, the Chilko run in particular, the Commission approved the following changes in regulations: 1. That Area 20 of Canadian Convention Waters opening be delayed 24 hours and for only one day of fishing for the week commencing August 6. 2. That United States Convention Waters and Areas 17, 18 and District No. 1 of Canadian Convention Waters not open as scheduled for the week commencing August 6. 3. That the Indian fishery on the Fraser River be reduced for one week to the following openings: (a) Below Mission, August 9, (b) Mission to North Bend, August 13, (c) North Bend to Texas Creek, August 12 and 13, (d) Texas Creek to Churn Creeek, August 16 and 17, (e) Churn Creek to Shelley, August 13 and 14.

August 11, 1978 — In the interest of escapement, the Commission approved the reduction of fishing time in Area 20 of Canadian Convention Waters to one day for the week commencing August 13.

August 18, 1978 — In the interest of ensuring appropriate harvest and adequate escapement, the Commission approved a reduction to 24 hours fishing in Area 20 of Canadian Convention Waters for the week commencing August 20.

August 21, 1978 — In the interest of division of catch, the Commission approved an additional 24 hours of fishing in Area 20 of Canadian Convention Waters.

August 22, 1978 — In view of the continuing abundance of Adams sockeye, the Commission approved a 24-hour extension of fishing time in Area 20 of Canadian Convention Waters and United States Convention Waters, making a total of three days fishing for the current week in these waters.

August 25, 1978 — The Commission approved the following regulation changes for the week commencing August 27: 1. That Area 20 of Canadian Convention Waters open as scheduled for one day of fishing. 2. That United States Convention Waters open as scheduled for one day of fishing. 3. That the entire District No. 1 of Canadian Convention Waters would open at 8:00 a.m. August 28 for one day of fishing.

September 1, 1978 — In the interest of division of catch and securing escapement of Adams sockeye, the

Commission approved the following regulation changes for the week commencing September 3: 1. That Areas 17, 18 and 20 of Canadian Convention Waters would be closed to fishing. 2. That United States Convention Waters remain closed. 3. That District No. 1 of Canadian Convention Waters easterly of the Brunswick Cannery-Oak Street Bridge line open from 8:00 a.m. to 7:00 p.m. September 5. 4. That District No. 1 of Canadian Convention Waters westerly of the "Blue Line" open from 8:00 p.m. September 5 to 7:00 a.m. September 6.

September 8, 1978 — In the interest of additional harvest of Birkenhead River sockeye, the Commission approved the following regulation changes: 1. That District No. 1 of Canadian Convention Waters easterly of the Brunswick Cannery-Oak Street Bridge line open from 8:00 a.m. to 8:00 p.m. September 10. 2. That Areas 17 and 18 of Canadian Convention Waters remain closed for the week commencing September 10. 3. That District No. 1 of Canadian Convention Waters scheduled opening for September 11 be cancelled.

September 11, 1978 - In the interest of additional harvest of the Birkenhead run, the Commission approved fishing in District No. 1 of Canadian Convention Waters easterly of the Brunswick Cannery-Oak Street Bridge line from 8:00 a.m. to 7:00 p.m. September 12.

September 21, 1978 — In the interest of protecting sockeye delaying in the Point Roberts area, the Commission approved the continuation of control and closure of the waters westerly of Lily Point line in United States Convention Waters for the week commencing September 24.

September 27, 1978 — In the interest of division of catch, the Commission approved 12 hours of fishing westerly of the "Blue Line" in District No. 1 of Canadian Convention Waters starting 7:00 p.m. September 28.

September 29,1978 — In the interest of additional escapement and in view of the declining abundance of sockeye in United States Waters, the Commission approved the following regulation changes: 1. That control of the waters between Lily Point line and Iwersen's Dock line of United States Convention Waters be relinquished effective 12:01 a.m. October 1. 2. That United States Convention Waters northerly and westerly of Iwersen's Dock line remain closed for the week commencing October 1. 3. That District No. 1. of Canadian Convention Waters not open for fishing as scheduled for the week commencing October 1.

October 2, 1978 — In the interest of division of catch, the Commission approved fishing westerly of the "Blue Line" in District No. 1 of Canadian Convention Waters from 7:00 p.m. October 3 to 8:00 a.m. October 4.

October 4, 1978 — In the interest of division of catch and additional harvest of remaining sockeye, the Commission approved 11 hours fishing easterly of the Brunswick Cannery-Oak Street Bridge line in District No. 1 of Canadian Convention Waters starting 8:00 a.m. October 5.

October 6, 1978 — Due to the declining abundance of sockeye salmon, the Commission approved the following regulations: 1. That control of the remaining United States Convention Waters still in Commission control be relinquished 12:01 a.m. October 8. 2. That control of District No. 1 of Canadian Convention Waters westerly of the "Blue Line" be relinquished effective 12:01 a.m. October 8. 3. That the Canadian Convention Waters still in Commission control remain closed until 12:01 a.m. October 12, at which time the Commission relinquishes control, thus completing the Commission's regulatory obligations for Convention Waters for the 1978 season.

SOCKEYE SALMON REPORT

The Fishery

The total 1978 Fraser River sockeye run was estimated at 9,480,000 compared with the preseason forecast of 6,500,000. It was the largest run since 1958 and exceeded the brood year run by about 864,000 fish. The number of Fraser sockeye entering Convention Waters was 5,424,000 of which 2,674,420 (49.3%) were caught commercially, 235,386 (4.3%) were taken by the Indian fishery, and 2,514,318 (46.4%) were recorded on the spawning grounds (see Tables I to VI in Appendix). An estimated total of 5141 non-Fraser sockeye, mainly from the run to Lake Washington in Washington State, were also caught in Convention Waters. The estimated catches of Fraser River sockeye in non-Convention Waters in Johnstone Strait and northern Strait of Georgia, and coastal waters north of Convention Waters, were 3,498,000

and 557,000 respectively. The non-Convention Waters catch of Fraser River sockeye migrating through Johnstone Strait was 52.0% of the total commercial catch of Fraser sockeye in all areas, and 36.9% of the total run.

The total 1978 Convention Waters catch of 2,679,561 sockeye was 2,282,133 fewer than in the brood year 1974 even though the total 1978 run was about 864,000 larger than in the brood year. In the Convention area, United States fishermen caught 1,362,446 sockeye (50.85%) and Canadian fishermen caught 1,317,115 sockeye (49.15%) (Appendix Tables I and II).

The proportion of the run approaching the Fraser River through Johnstone Strait in 1978 was unprecedented. The last such diversion of the run was in 1958 when 35% of the Fraser River sockeye run came through Johnstone Strait. However, in 1978 it is estimated that a record 58% of the total Fraser run came through Johnstone Strait. Coastal sea water temperatures off Amphitrite Point in June were high, similar to 1958, and temperatures near the entrance of Quatsino Sound near the top of Vancouver Island in August 1978 were warmer than in 1958 for the same period. However, it is not known what role, if any, sea water temperatures had in relation to the high diversion rate in 1978.

The unusual 1978 migration pattern, combined with highly efficient fisheries outside Convention Waters, resulted in the lowest percentage on record of any Fraser River sockeye run reaching Convention Waters. In 1978 only 57.2% of the total Fraser run reached Convention Waters compared with 76.9% in 1958 and 80.4% in 1974, and the Convention Waters catch was only 28.2% of the total run compared with 57.5% in 1974 (Table 5). The difference between the two years is primarily the result of the high diversion rate in 1978 (58%) compared with 22% in 1974, with the approximate 800,000 increase in escapement in 1978 as an additional factor (Table 6).

Table 5. Fraser River sockeye total runs and catches.

	1958	1974	1978
Total Fraser Run	18,780,000	8,616,000	9,480,000
Convention Waters Run	14,450,000	6,931,000	5,424,000
Percent of Run Reaching Convention Waters	76.9	80.4	57.2
Convention Waters Catch	10,500,000	4,952,000	2,675,000
(Percent of Total Run)	(55.9)	(57.5)	(28.2)
Non-Convention Waters Catch	4,331,000	1,684,000	4,056,000
(Percent of Total Run)	(23.1)	(19.5)	(42.8)
Total Fraser Catch	14,831,000	6,636,000	6,730,000
(Percent of Total Run)	(79.0)	(77.0)	(71.0)

Table 6. Fraser River sockeye catches and escapements.

	1974	1978
Non-Convention		
Nets	1,263,000 (14.65%)	3,254,000 (34.32%)
Troll	422,000 (4.89%)	802,000 (8.46%)
Convention	4,527,000	2,446,000
Nets	(52.55%)	(25.80%)
Troll	425,000 (4.93%)	229,000 (2.42%)
Indian	222,000 (2.58%)	235,000 (2.48%)
Escapement	1,757,000 (20.40%)	2,514,000 (26.52%)
TOTAL RUN	8,616,000	9,480,000

The increasing effort and efficiency of the coastal troll fishery, Johnstone Strait net fishery and Fraser River Indian fishery in recent years has resulted in an increased percentage of the total Fraser run being removed, and consequently a lower percentage of the total run is available for catch by the traditional Convention Waters net fisheries (Figure 5). During the period 1953-1956 an annual average of 6.5% of the total Fraser run was caught by these three fisheries (range 1.8 to 9.1%), whereas in recent years (1975-1978) an annual average of 23.8% of the total Fraser run was taken in locations where the catch is not included in division between fishermen of the two countries. In 1978, primarily as a result of the high diversion through Johnstone Strait, a record 45.3% of the total Fraser run was caught in these fisheries.

In Canadian Convention Waters, 721,141 (54.8%) sockeye were taken in the waters westerly of William Head while 595,974 (45.2%) sockeye were caught easterly of William Head mainly near or in the Fraser River. The percentage of the total run and catch taken in the Convention Waters fisheries westerly of William Head in 1978 was the lowest on the cycle since 1966 (53.2%) (718,761). The Fraser River area catch in District 1 for 1978 was 552,807 sockeye, the lowest since 1962. This catch formed only 5.8% of the total Fraser River sockeye run and illustrates the declining percentage of the run that is taken in this traditional Convention Waters fishing area. For comparison, in 1946, the first year of Commission regulatory control, the total Fraser

run was about 10,700,000 compared with 9,500,000 in 1978 and the total catch in District 1 was 2,552,000 sockeye, or 23.8% of the total run.

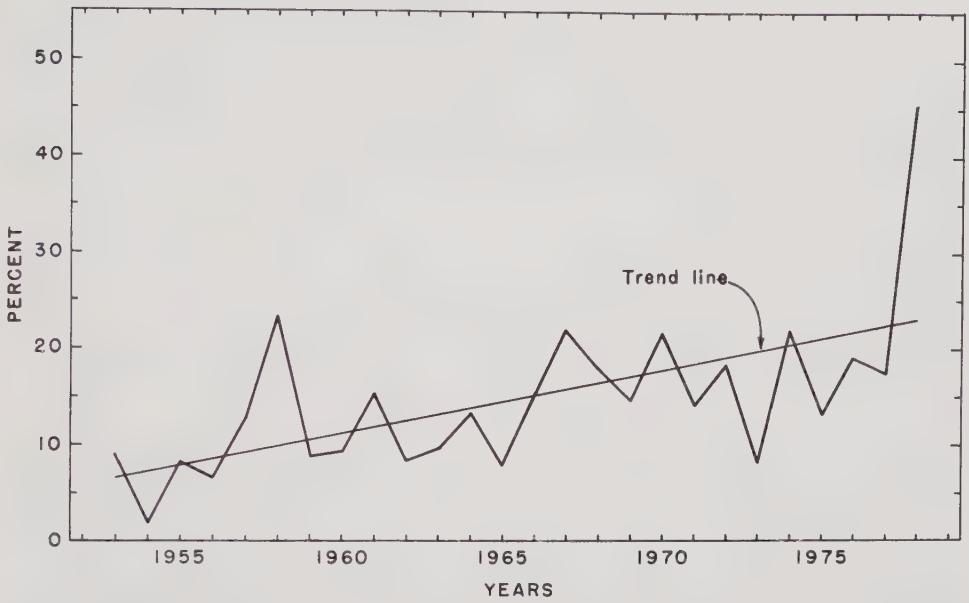

Figure 5. Combined exploitation of Fraser River sockeye outside of Convention Waters and in the Fraser River Indian fishery.

Table 7. Canadian Convention Waters sockeye catch by area.

		Number	*Percent*
Area 20 - 24	Troll	153,457	11.65
Area 17 - 18	Troll	20,099	1.53
District 1	Troll	56,450	4.28
Area 20	Purse Seine	438,753	33.31
	Gill Net	128,931	9.79
Area 17 - 18	Purse Seine	21,850	1.66
	Gill Net	1,218	0.09
District 1	Gill Net	496,357	37.69
		1,317,115	100.00

The percentage and catch by purse seines (34.97%, 460,603) (TABLE 1 in Appendix) was considerably below the brood year (41.79%, 1,044,742). The total gill net catch in 1978 was 626,506 (47.57%), the lowest total catch by that gear on the cycle since 1950. In spite of the lowered volume of catch, the percentage of catch (47.57%) increased from the 41.19% taken in the brood year. Although the percentage of catch taken by trollers in Canadian Convention Waters increased slightly to 17.46%

compared with the previous record high of 17.02% taken in the brood year, the catch of 230,006 sockeye was only a little more than one-half the total caught in 1974 (425,599).

Although the share of the total Fraser run taken by fishermen fishing in District 1 has been declining, the proportion of the total Canadian Convention Waters catch taken by gill nets in this area did increase in 1978 to 37.69% compared with only 28.10% in the brood year. A decreasing percentage of the Canadian Convention Waters catch had been taking place on each cycle since 1962 up until 1978. The 1978 percentage (37.69%) was the largest on the cycle since 1966.

Table 8. Canadian Convention Waters District 1 gill net sockeye catch, percent.

Year	1962	1966	1970	1974	1978
Percent	63.28	46.46	36.66	28.10	37.69

In United States Convention Waters, the purse seine catch (694,460) was the lowest on the cycle since 1962 (505,028) and less than half the brood year catch (1,515,444) (TABLE 1 in Appendix). The percent taken by seines was the lowest ever for the cycle (50.97%). The percentage caught by gill nets (46.67%) was the largest recorded for the cycle although total catch (635,795) was below the catch made in the brood year (873,595). Reef nets caught 31,832 sockeye in 1978, the lowest number on the cycle since 1938 when 24,408 were caught. The percentage of the total United States catch taken by reef net gear (2.34%) was also the lowest on the cycle since 1938 (1.73%). The total United States catch of Fraser sockeye formed only 14.3% of the total Fraser run, and 19.5% of the catch made in all areas.

Fishing effort in all of Convention Waters was reduced in 1978, compared to 1974, as a result of large pink salmon runs in Southeastern Alaska and the high diversion of Fraser River sockeye through Johnstone Strait.

Table 9. Fishing units operating in Convention Waters.

	1970	1974	1978
Canadian Convention Waters			
Purse Seines (Area 20)	87	133	46
Gill Nets	1,263	1,000	950
	1,350	1,133	996
United States Convention Waters			
Purse Seines	191	272	220
Gill Nets	492	1,140	999
Reef Nets	41	54	47
	724	1,466	1,266

Although fishing effort in Convention Waters in 1978 was below that of the brood year and in spite of increased run size in 1978 compared to 1974, total fishing days allowed were well below recent cycle years and the lowest of any cycle year. This action was necessary to insure that escapement goals were met in view of the large removal of sockeye in non-Convention Waters fisheries.

Table 10. Number of fishing days allowed.

	1970	1974	1978
Area 20	11	11	8
District 1	14	20	14
United States	24	19	11*
	49	50	33

*Commission regulations.

The United States Government granted special fishing times to treaty Indians on days closed to fishing under Commission regulations again in 1978 as was done in 1977. During the period from July 16 to September 9, a total of 123,044 sockeye were taken by Indians on these extra fishing days, 62,876 by Indian gill nets and 60,168 by Indian purse seines. This catch constituted 9.0% of the total season's catch by all United States fishermen. During the previously stated time period, Commission regulations permitted eleven days fishing in United States Convention Waters whereas the United States Government gave certain treaty Indians 18 fishing periods in State Areas 7 and 7A and 25 fishing periods in Juan de Fuca Strait.

The Adams River sockeye population in 1978 was about 6,300,000 fish, the largest run since 1958. It is probable that the return would have been significantly larger if overfishing had not occurred in 1974. The Adams run has increased in each cycle year since 1962 when the run reached a low of about 2,000,000 fish.

The Lower Shuswap River run in 1978 was about 700,000 sockeye compared to 406,000 in 1974. The 1978 return was probably the largest since 1909 and the impact of the great potential of the spawning area contained in this river becomes more evident with each cycle return. The total return in 1970 was just 72,000, thus there has been an approximate tenfold increase in the total stock size during this short time period up to 1978.

Other stocks that contributed significantly to the catch in 1978 were Chilko, Birkenhead, Stellako and Weaver Creek.

Rates of production for races of the Shuswap Lake system were all fairly good in 1978 and Adams River brood females produced about 11.1 adults per female spawner while the Lower Shuswap run returned at 13.9 per female spawner. Seymour sockeye returned about 7.2 adults per female spawner.

The average weight of 4-year-old sockeye during the period from July 22 to September 1 was 6.45 pounds, essentially the same as the long term cycle average (1918-1974) of 6.41 pounds.

Escapement

The net escapement of 2,514,318 sockeye represented 46.4% of the 1978 Fraser run to Convention Waters and 26.5% of the calculated total Fraser River run. The total escapement was the largest since 1958 and represented substantial improvement for future potential in many spawning areas.

The escapement goal for Early Stuart sockeye was 100,000 fish and the actual escapement reaching the spawning grounds was 50,097 (TABLE VI in Appendix). The total escapement was the largest on the cycle since 1950. Practically no fishing occurred in Convention Waters in 1978 on this race and about 76% of the total run entered the Fraser River. The recorded Fraser River Indian fishery catch of this race in the Fraser River and tributaries amounted to 59,000 sockeye. This catch was disproportionately high compared with other stocks and formed about 41.3% of the total recorded Early Stuart run. The Indian fishery catch of Early Stuart sockeye formed about 25% of the total season's catch of all races made by this fishery whereas the Early Stuart total run formed only 1.5% of the total Fraser run. In addition to the disappointing total escapement reaching the spawning grounds, there was about 28% reduction of effective spawners at the spawning grounds due to prespawning mortality, thereby reducing the 1978 brood year potential to less than that recorded four years ago. The Commission-recommended reduction in fishing times in 1978 in the Fraser River Indian fishery during the time of passage of the Early Stuart sockeye was not implemented as recommended to the Canadian Government.

Escapement to the Late Stuart streams totaled 13,027 fish, down slightly from the brood year escapement of 14,627.

The Bowron River escapement of 3150 was about double the brood year escapement and the largest on the cycle since 1966. For the second consecutive cycle year there were no spawners on the Early Nadina River spawning grounds. The Late Nadina escapement of 2782 was below the brood year level (3825) and the lowest on the cycle since 1966. The numbers of sockeye using the Nadina spawning channel in 1978 increased to 2555 compared with 895 in 1974. The Stellako escapement improved substantially in 1978 to a total of 60,421 compared with 41,473 in the brood year and this was the largest cyclic escapement since 1966.

At Horsefly River the escapement increased to 7287 from 4459 in 1974. This return marks a continuing buildup of a subdominant run and was the largest escapement on record for the cycle. Of further significance is the fact that about 90 percent of the return consisted of four-year-old adults from the 1974 brood spawning. Another promising aspect of the return to the Quesnel area was that some spawners (484) utilized the spawning area in the Lower Horsefly River and 1237 fish were observed in Mitchell River, the largest number ever seen on this cycle. Further increase in the size of these stocks on this cycle is desirable.

An excellent escapement of 159,174 spawners was obtained in the Chilko Lake system with 151,835 in the Chilko River and 7339 at the south end of Chilko Lake. Total escapement was at the desired level and was the largest on the cycle since 1966.

Escapement into Raft River (2500) showed a slight increase in 1978 compared with the brood year (2396). In both 1954 and 1958 about 10,000 spawners returned, therefore significant increase in the escapement would be desirable. The Upper

Adams River transplant in 1974 of Seymour River eggs failed to produce any returning sockeye to the spawning grounds.

The Shuswap Lake system accounted for approximately 75 percent of the total Fraser return in 1978 and excellent escapements were obtained for the races utilizing Shuswap Lake. The early run to Seymour River had an escapement of 62,929, the largest on the cycle since 1958. A total of 2056 early run Scotch Creek spawners returned, the largest ever on the cycle. Escapement of the late run to Adams and Little Rivers was 1,574,528 compared to the near optimum of 1,939,071 in 1954. There also were 62,000 spawners along approximately 15 miles of beach spawning area of the main arm of Shuswap Lake where the Adams River enters the lake, and an additional 38,101 beach shore spawners were observed at Seymour Arm, Salmon Arm and Anstey Arm. The total escapement to the Adams River area was the largest since 1958.

The escapement to Lower Shuswap River of a record 187,167 spawners was more than double the brood year return, thus providing a further substantial potential for 1982. Escapement into Middle Shuswap River also increased significantly to 10,890 fish compared with 3064 in the brood year. This was the largest escapement ever recorded in this river.

Further improvements in escapements at Gates Creek and Portage Creek were also observed, with escapements of 2570 and 10,230 in the respective areas. The escapements represent moderate gains compared with escapement levels in 1974.

Total escapement to Birkenhead River in 1978 declined to 99,857 compared with the record high 173,463 spawners in 1974. However, the adult portion of the escapement was 94,782 in 1978 compared with 119,637 in 1974, thus the potential for 1982 is not significantly reduced in relation to that available for the 1978 return. At Weaver Creek a total of 76,237 sockeye were observed, with 32,248 in the spawning channel. This was the largest escapement on record for the Weaver Creek run, about 10,000 greater than in the brood year. Escapement to Harrison River was the largest (19,747) on the cycle since 1966.

The Pitt River sockeye escapement of 24,835 was the largest for this cycle since 1950 (42,800). At Cultus Lake total escapement was 7265 in 1978 compared with 9814 in the brood year.

Success of spawning was good in all areas except at Early Stuart (28% loss) and at Gates Creek (25% loss).

The Salute to the Sockeye display at Adams River attracted 160,000 people, and 40,000 visitors viewed the sockeye spawning at the Weaver Creek spawning channel.

The Indian fishery catch in the Fraser River and its tributaries was 235,386 sockeye, the largest ever for the cycle. This catch represented 2.5% of the total Fraser run.

The daily escapement of sockeye past Mission was estimated by echo sounding again in 1978. Echo sounding was performed from June 27 to August 27 and from September 18 to October 4, during which time 95% of the season's escapement occurred. The total season escapement was estimated by echo sounding at 2,599,000 sockeye, while the recorded escapements at the spawning grounds plus the Indian

fishery catch totaled 2,750,000 sockeye, 5% more than the echo sounding estimate. Cumulative escapement of summer run sockeye was estimated by echo sounding at 710,000 fish which compared with a recorded gross escapement of 671,000 sockeye. Late runs totaled 2,079 fish in the gross escapement while the echo sounding estimate was 1,889,000 fish, or 9% less.

Developments in echo sounding techniques resulted in improved accuracy of escapement estimates in 1978. Improvements in sounding gear and survey technique should result in continued reliability in the echo sounding estimates of escapement.

SPAWNING CHANNEL OPERATIONS

Fry production from the 1977 spawning of sockeye and pink salmon at channels operated by the Commission is given in Table 11.

Table 11. Sockeye and pink salmon fry production from the 1977 brood spawning and incubation channels.

Site	*Species*	*Eggs Deposited*	*Fry Produced*	*Percent Survival*
Upper Pitt	Sockeye	4,909,000	3,648,00	74.3
Weaver Creek	Sockeye	77,715,00	19,520,000	25.1
Gates Creek	Sockeye	2,602,000	1,898,000	72.9
Nadina River	Sockeye	28,039,000	14,213,000	50.7
Upper Seton	Pink	15,200,000	7,206,000	47.4
Lower Seton	Pink	39,300,000	22,598,000	57.5

At the Upper Pitt River incubation channel the number of eggs taken was the largest since start of operation in 1963, the number of eggs planted in the channel was the third largest, and the number of fry produced was the fourth largest. The survival from eyed eggs planted to fry was 85.4% which is below the average of 91.9%, but this is not the result of the number of eggs planted as survivals of 93% have been obtained with larger numbers of eggs planted.

At the Weaver Creek spawning channel the number of sockeye eggs deposited was the largest since start of operation in 1965 and the density of spawners was also the largest, with 1.05 female sockeye spawners per sq yd. At the average survival of 72.7% for previous years about 56 million sockeye fry should have been produced, but as a direct result of the flooding of the channel area on November 1, 1977 caused by a log jam in Weaver Creek at the highway bridge and the ensuing deposition of silt and debris on the channel bed, the survival was only 25.1% and only 19.5 million fry were produced. Even so, the channel accounted for 98% of the Weaver Creek fry output in

1978 as survival in the stream was only 0.73% because of the effects of the flood. As shown in Figure 6, this large deviation from the expected survival in the channel cannot be attributed to spawning density. The reduction in the survival of eggs in Weaver Creek and in the channel will mean a reduction of catch in 1981.

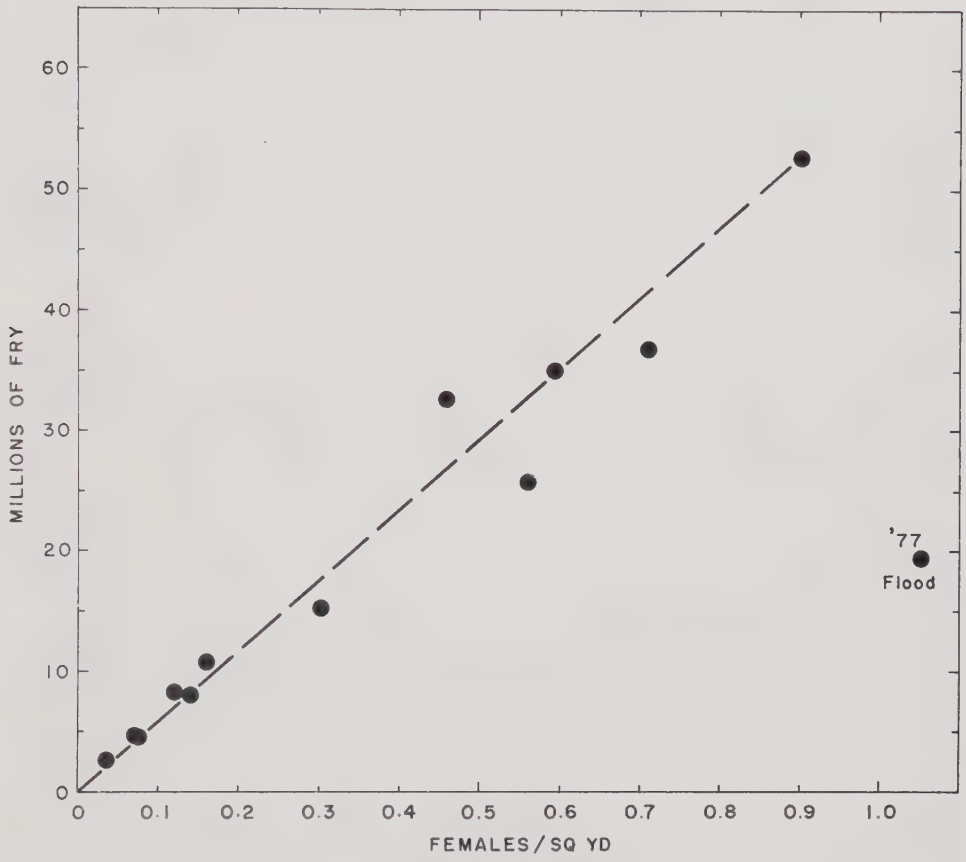

Figure 6. Sockeye fry production in relation to spawning density in the Weaver Creek spawning channel.

At the Gates Creek channel the number of fry produced was double that for the previous cycle, giving a substantial boost to this subdominant cycle run. At the Nadina River channel, the number of eggs deposited was over double the brood year and the number of fry produced was the largest since start of operation in 1973. A progressive decline in the survival rate has been observed from 74.2% to 52.0% for the brood years 1973, 1975 and 1977 as the number of spawners has increased. Spawner density of 0.41 females per sq yd in 1977 is still quite low in relation to natural spawning grounds and in relation to the Weaver Creek spawning channel, and additional data from years with higher spawning densities will be needed before it can be determined if the trend in survival is related to spawner density.

The numbers of pink salmon fry produced by each of the two spawning channels at Seton Creek were the largest recorded yet for these projects. At the lower channel the density of spawners increased to 0.95 females per sq yd in 1977 with no apparent effect

on survival to fry. At the upper channel a spawner density of 1.19 females per sq yd appeared to lower the survival to fry and the data suggest that optimum output of fry would be obtained at a spawner density of about 1.0 to 1.1 females per sq yd.

The total Pitt River sockeye run in 1978 was estimated at 60,100, of which 19,400 were produced by the incubation channel (Figure 7). About 44% of the return was 5-year-old fish from the 1973 spawning. The balance was almost all from the spawning in 1974 which represents a very low partial return from the 13 million fry produced by Pitt River from that brood year. The total Weaver Creek sockeye run in 1978 was estimated at 274,000 fish, of which 233,000 were produced by the channel. This was the fourth largest run since the channel started operating. The average total run for the years 1969-1978 has been 234,600 sockeye, compared to an average of 84,414 sockeye in the years 1952-1968 prior to the returns produced by the spawning channel (Figure 8). The run in 1978 was smaller than the run of 420,900 sockeye in 1974 (Figure 9), although there were over four times as many fry to produce the 1978 run compared to the 1974 run.

The 1978 cycle run to Gates Creek is the smallest of the four cycles, but the total run increased from only 493 in 1974 to 1122 in 1978, practically all produced by the spawning channel. The 1978 cycle Late Nadina run is one of two small off-year runs. The return in 1978 was estimated at 12,800, a substantial decrease from 30,330 in 1974 despite the contribution of the spawning channel to fry output.

The number of eggs taken for the Upper Pitt River incubation channel in 1978 was 4,953,000, the largest yet obtained. The number of spawners in the Upper Pitt River system was also the largest since 1950. At Weaver Creek, the number of sockeye spawners in the channel (32,248) was about one-third more than in 1974 and was the highest obtained on the cycle. The number of spawners in the natural spawning grounds of Weaver Creek (43,989) was also the largest obtained on any cycle since the start of records in 1938. At the Gates Creek channel the number of adult spawners increased from 64 in 1974 to 147 in 1978, and in the natural spawning area in Gates Creek the number of adult spawners also increased from 6 in 1974 to 110 in 1978, providing increased potential for continued growth on this small cycle year. The number of sockeye spawners in the Nadina River channel increased from 895 in 1974 to 2555 in 1978, but the number of Late Nadina spawners on the natural spawning area decreased from 2930 in 1974 to 227 in 1978. This shift in distribution of spawners should be advantageous for fry production because of the higher survival of eggs in the channel, and thus provides increased potential for the 1982 return.

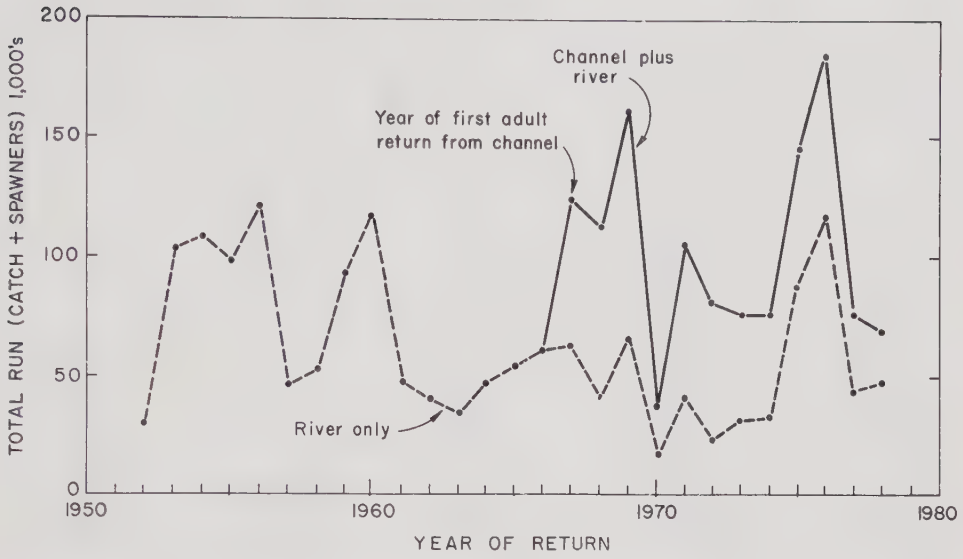

Figure 7. Sockeye production from Pitt River and Pitt River incubation channel, 1952-1978.

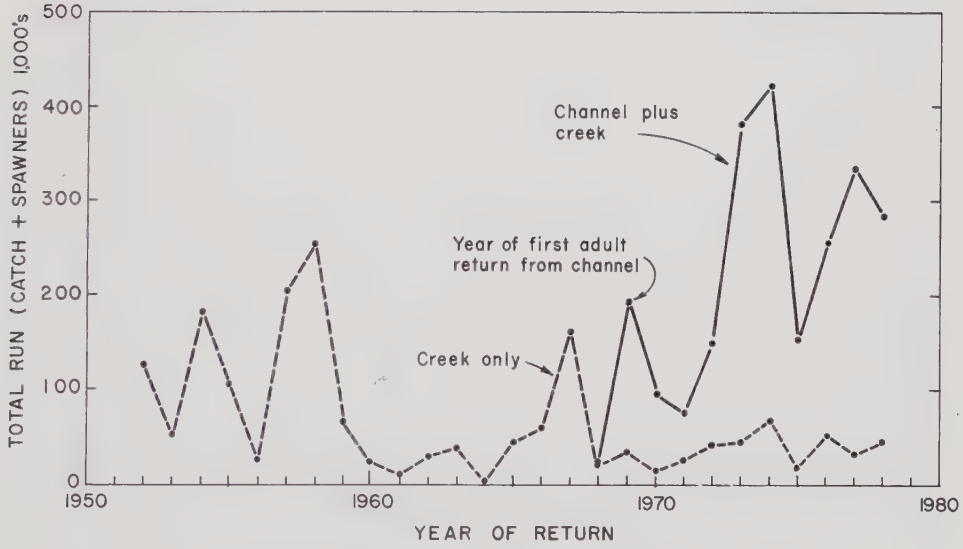

Figure 8. Sockeye production from Weaver Creek and Weaver Creek channel, 1952-1978.

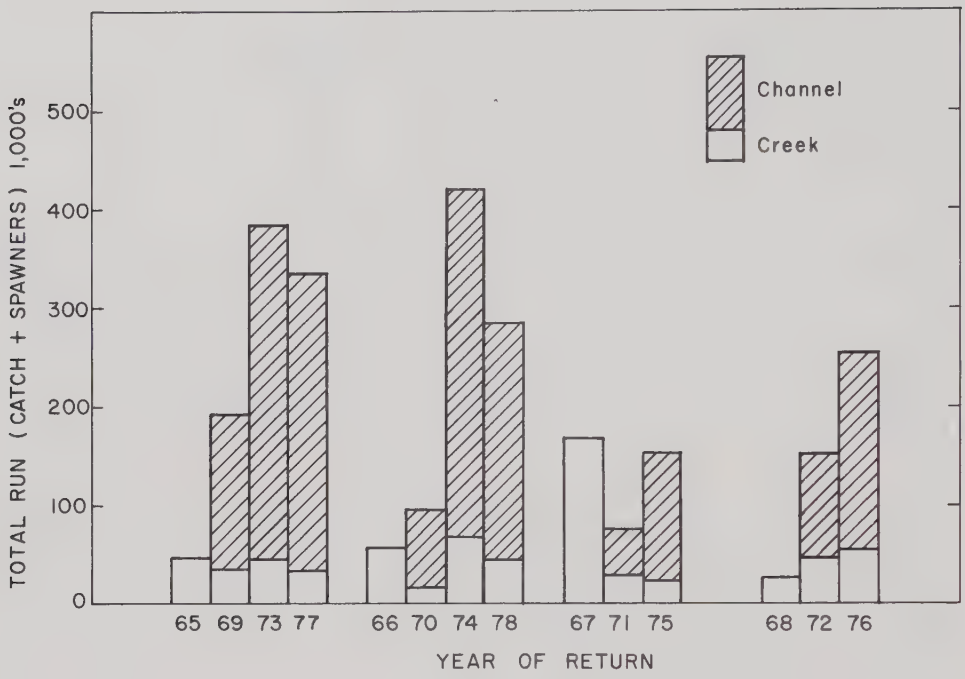

Figure 9. Sockeye production from Weaver Creek and Weaver Creek channel, by cycles, 1965-1978.

RESEARCH

The major emphasis of the research program in 1978 was the continuation of investigations of the lacustrine biology of sockeye salmon. The Commission began applying acoustic techniques in 1971 to assess the population, distribution, and movements of juvenile sockeye salmon in the major rearing lakes in the Fraser River watershed. Up to 1977 the survey data were collected on paper recordings and analyzed manually. In 1978, equipment was obtained to record the data on magnetic tape for subsequent analysis by computer. This improves the ability to enumerate dense populations of fingerlings and removes much of the subjectivity of the population estimates. Resident fish species are collected with tow net hauls taken in conjunction with the acoustic surveys. These samples are then separated by species, weighed and measured, and scale samples are taken to distinguish juvenile sockeye from kokanee. During 1978, 15 lakes were surveyed at least once during the season and 120 net tows were made. Analyses of the data will not be completed until mid 1979.

The standing crop of zooplankton, and water conductivity and transparency, were measured during 1978 at all major rearing lakes of the Fraser River system, with emphasis on Quesnel, Cultus and Pitt Lakes. To facilitate study, the many years of accumulated data are being placed on magnetic tape for computer analysis.

The Cultus Lake sockeye feeding study which began in 1976 was continued until February 1978. The object of this investigation was to determine what part of the food resource the fry were utilizing and the effect of predation on future zooplankton populations. The data indicate that the sockeye select the cladocerans *Daphnia* and

Bosmina over calanoid and cyclopoid copepods. They also select adult plankters over immature forms. The heavy feeding during 1975 and 1976 by progeny from 5354 and 7343 effective female spawners, respectively, did not have a holdover effect in 1977 as the percentage of cladocerans in the zooplankton population in Cultus Lake increased from 38.8% in 1976 to 49.5% in 1977 (Table 12). In 1977 there were only 41 female spawners and the 47.7% cladocerans in 1978 was similar to 1977.

Table 12. Average percentage of cladocerans and copepods in Cultus Lake compared with number of female spawners as an index of number of fry in residence during the following year.

Brood Year	*Number Female Spawners*	*Fry Residence Year*	*Percent Cladocerans*	*Percent Copepods*
1974	5,354	1975	37.1	62.9
1975	7,343	1976	38.8	61.2
1976	2,884	1977	49.5	50.5
1977	41	1978	47.7	52.3

A feeding study was started at Pitt Lake in April of 1978. The purpose of this study is to obtain data on the feeding habits of sockeye fry in a lake with substantial populations of potential competitors. Data obtained in April and May suggest that the fish were feeding exclusively at dusk. Smelt appear to be the dominant fish population in Pitt Lake. Examination of the stomachs of smelt captured in the trawl samples indicated that early in the season, primarily April and May, the smelt are eating very little with *Cyclops* virtually the only species consumed. In June all smelt sampled had eaten and the main food organism was *Epischura*. Sockeye fry sampled in April and May still had an appreciable amount of yolk and did not appear to be feeding. No O age sockeye were captured on subsequent trips to Pitt. A few age 1 sockeye or kokanee were caught in April, May and June. In April these fish were eating *Cyclops* primarily, but in May and June the sockeye appear to shift to eating only insects. More intensive sampling will be done early in the spring and summer of 1979 to examine the distribution and movement of O age sockeye fry in Pitt Lake.

An acoustic survey was made in Georgia Strait to obtain a qualitative assessment of the abundance of Adams and other late run sockeye. Large schools were detected in September but were no longer present in December. The data will be used for comparisons in future years to see if the method will give a usable estimate of the numbers of salmon present.

The bacterial disease vibriosis was a serious problem in salt water rearing of Pacific salmon prior to the development of a vaccine, and the question arises as to the effect of vibriosis on sockeye and pink salmon. In an attempt to answer this question, 25,000 Cultus sockeye smolts were vaccinated against vibriosis, marked and released in the spring of 1978. Another control group of 25,000 smolts were marked and released simultaneously. The adults returning in 1980 will be screened for marks, and survivals of the two groups will be compared.

It has been reported previously that IHN (Infectious Haemotopoietic Necrosis)

virus was considered a serious problem for the 1972 brood Chilko fry. As reported last year, IHN was isolated from the Chilko fry in 1977 and the 1977 fry estimate suggested that once again IHN could be a problem. However, the number of smolts emigrating from Chilko Lake in the spring of 1978 was within the normal range expected from the number of eggs deposited and there was no evidence of IHN. An unusual number of moribund smolts was observed, but the Fish Health Group at the Pacific Biological Station did not detect IHN or other pathogens in samples submitted for analysis. In addition, the total run produced by the 1972 brood is now estimated at 2.1 million sockeye, the fourth largest since 1948, and this is a normal run size for the number of spawners that produced it. It is concluded that IHN has not been as serious a problem as suggested by its identification and concurrent fry observations at Chilko River.

The previously reported cooperative diagnostic examination of moribund sockeye from the dominant 1977 Horsefly sockeye population, which had 40.3% prespawning mortality, did not indicate any known infectious agent which could cause prespawning mortality. However, in some fish a heavy sporozoan parasitic infection was found in the kidney tissue. Sockeye from the 1978 subdominant Horsefly population were examined for possible health problems related to prespawning mortality. The prespawning mortality in 1978 was only 1.6% and no recognizable pathogens were detected. Once again a myxosporidia parasite was found in the kidneys of the fish. This would suggest that the parasite was not a serious contributor to prespawning mortality.

The 1978 Early Stuart sockeye escapement to the spawning grounds had a prespawning mortality of 28.4%. Previous reports (1973) on the Horsefly River sockeye run suggest that average maximum daily water temperature at Hell's Gate and the relative timing of the run, i.e. whether early or late, are related to the extent of prespawning mortality. The 1978 Early Stuart run was about 4 days earlier than average, with a large segment migrating earlier than any previously recorded significant escapement. Water temperatures at Hell's Gate during passage of the run averaged 63.0°F. The observed prespawning mortality appears to be minimal for these conditions based on experience with the Horsefly run. The Stuart and Nechako Rivers were surveyed from Fort St. James to Prince George during the time of migration. The sockeye appeared to be in good condition and only one dead sockeye was seen. Water temperatures ranged from 66°F to 69°F during the survey, and dissolved gas concentration ranged up to 106% of saturation values.

The program to investigate the feasibility of producing an even year pink salmon brood stock of Fraser River origin was terminated in 1978. The 1975 brood Seton Creek pinks suffered heavy mortalities in their third year and all died prior to spawning in the fall of 1978. The cause of death was attributed to kidney disease. This program has shown that photoperiod manipulation is capable of producing 3-year-old pink salmon, as was demonstrated by the spawning of 1973 brood Seton pinks in 1976 at the Sweltzer Creek Laboratory. However, the progeny of these fish died from bacterial gill infection in 1977. Further application of this technique to develop an even year stock of pinks seems unwarranted until effective means of prevention or treatment are available for the diseases that are encountered.

As reported last year, an effort was made to offset some of the prespawning mortality of Horsefly River sockeye by salvaging eggs from moribund unspawned females. The feasibility of egg salvage had been demonstrated by tests at McKinley

Creek in 1973, and 80% survival from eggs to fry was obtained from 300,000 eggs salvaged at Gates Creek channel in 1976. In 1977, 6,347,000 eggs were salvaged from moribund Horsefly River sockeye females and were planted in the spawning bed at the outlet of McKinley Lake that was constructed in 1969 in conjunction with the temperature control structure. However, only an estimated 19,939 fry were produced. Reasons for the poor production cannot be established definitely, but viability of the eggs and/or sperm are suspected causes.

The upwelling flow gravel incubation channel at the Sweltzer Creek Field Station, originally constructed for research purposes, was put into productive operation in 1978 to give fry production of Cultus Lake sockeye a boost. Returns of this stock have been well below average for the last three years. Eggs from 291 females, or about 9% of the spawners, were taken and are being incubated at the laboratory for planting in the gravel bed when they are eyed. The fry produced will be released in Cultus Lake to rear. This process should result in greatly increased survival to fry for the 667,800 eggs taken, and could increase total sockeye fry production in Cultus Lake from the 1978 brood by about 50%.

An experiment was carried out at the Sweltzer Creek Laboratory to compare the visibility of marks from various branding techniques for periods up to two weeks after death. Three groups of ten jack sockeye were branded and held in a concrete pond until death. The first group was marked with a solution of silver nitrate applied to the side of the salmon with a cotton applicator, the second group was marked with a hot brand and the third with a cold brand using dry ice and methanol as the cooling agent. After death the fish were left on the banks of the Sweltzer Creek as they would be during a normal enumeration dead pitch. All of the marks were easily visible up to one week after death, but at two weeks the hot brand would not be readily visible in normal field procedures. The silver nitrate and the cold brand were considered superior to the hot brand.

Research into the biology of Gates Creek fry in the Seton-Anderson system has indicated that the majority of sockeye fry migrate directly through Anderson Lake into Seton Lake where they rear to smolts. Examination of fry migrating down Portage Creek from Anderson Lake to Seton Lake suggests that although there is an adequate food supply in Anderson Lake, the Gates Creek sockeye leave the lake a month after leaving Gates Creek with very little evidence of growth and with substantially reduced numbers. In order to assess the possible advantages of bypassing the Anderson Lake stage of the early life of Gates sockeye, 52,282 fry were captured from the Gates channel in 1978 and marked. Approximately half of these fry (26,110) were transported to the outlet of Anderson Lake and released in Portage Creek, while the other half (26,172) were released into Gates Creek. The survival of the two groups will be compared upon the return of the adults to Gate Creek in 1980.

A variety of methods of forecasting the marine survival of Chilko sockeye and Fraser pinks are under continuous study and revision. One of these approaches places primary emphasis on those environmental factors showing the best simple correlation with marine survival. The factors are examined as broadly as possible in time and space, whether or not there is a plausible theoretical explanation for the statistical relationships. For example, for Chilko sockeye the factor which accounts best for most of the past variation in survival is the coastal air temperature of the winter preceding the outmigration of smolts. This method predicted a 7.5% return of Chilko

sockeye in 1978, compared to an adult return of 7.1%. For Fraser pinks, the best simple correlations are those with coastal water salinities and river discharges in southwestern Vancouver Island in late summer of the first marine year, but these give quite diverse predictions for the 1979 pink return.

Other types of analysis have been made to try to check the usefulness of this primarily "statistical" approach to forecasting marine survival of these salmon. Marine survival data for several other stocks of all species of North American Pacific salmon were compared with the local values for the same type of environmental factors as those mentioned above. No other stock or species showed a strong correlation between marine survival and prior winter air and sea temperatures. On the other hand, many stocks and several species showed a fairly strong correlation with river runoff and surface salinities late in the first marine summer similar to the correlations observed for Fraser pinks, thus providing indication that these correlations may not be spurious. The literature on distribution, physiology and behaviour of salmon is being studied for any evidence of possible connection with the environmental factors and the marine survival of salmon. Much speculation but little hard evidence has come from this type of analysis so far.

The method of predicting the size of the pink salmon run based on the hypothesis presented in the 1973 Annual Report predicted 1.6% survival for the 1977 run, whereas actual survival was 2.9%. The method was reviewed during 1978 in preparation for the prediction of the 1979 pink run and on the basis of the statistical analysis referred to above, river discharge in southwestern Vancouver Island in the summer of the year of fry emigration has been included as an additional factor. However, because of certain unresolved aspects of interpretation of this factor, the correlation with salinity at Amphitrite Point, previously mentioned in the 1976 Annual Report, was used for the 1979 prediction.

Environmental correlations have also been examined with respect to forecasting timing of the sockeye runs and the proportion of diversion into Johnstone Strait. Winter and spring sea surface temperatures at Ocean Station P in the year of adult return indicated within a few days the timing of the peak of the Adams River run at the entrance to Juan de Fuca Strait. The Station P temperatures were near average for the period in 1978 and timing of the run was average, whereas in 1958 the temperatures were the highest in available records and the run was the latest on record. This contrasts with coastal surface temperatures for winter and spring which were well above average in both 1958 and 1978.

In 1978 the percentage of Fraser sockeye which returned via Johnstone Strait was the largest on record by a considerable margin. A diversion rate of this magnitude was not predicted by any of the near-coastal environmental factors and models that had been used in recent years with some success, and obviously further study is necessary.

ENVIRONMENT PROTECTION

Expanded wastewater treatment facilities at Prince George Pulp and Paper Ltd. and Intercontinental Pulp Ltd. started operating in January 1978. Treatment consists of pH neutralization, sedimentation, pretreatment of a portion of wastewater flow in a

24-hour activated sludge unit and 4.3-day treatment of combined flow from both mills in an aerated lagoon. Effluent met objectives for BOD and detoxification during its first year of operation. Effluent is discharged to the Fraser River through a multiport diffuser, and following on site measurements of dilution at the river diffuser the Companies reported dilution met provincial objectives at low and high river flows.

A period of substandard treatment of wastewater at Cariboo Pulp and Paper Ltd. at Quesnel was experienced in 1977 due to increased load on the aerated lagoon treatment system. Major refitting and modifications were undertaken in the mill and five aerators were added to the aerated lagoon to overcome the problem. Measurements in 1978 showed an improving trend as effluent usually met BOD and toxicity objectives.

The Pollution Control Branch issued a discharge permit to the Belkin Paperboard Ltd. wastepaper recycling plant on the North Arm of the Fraser River downstream of New Westminster. The permit specified that a study must be conducted to determine causes of effluent toxicity and methods of detoxification to meet provincial objectives. A solution was not reported at year's end and studies are continuing.

Upon expiration of their Pollution Control Branch discharge permit, Island Paper Mills at Annacis Island elected to discharge wastewater to the municipal sewer system tributary to Annacis Island sewage treatment plant. Seventy percent of effluent samples from Island Paper Mills met provincial objectives for toxicity in 1978.

In a somewhat similar but earlier case, the Canadian Forest Products hardboard plant in New Westminster ceased discharge to the Fraser River and directed wastewater to Annacis Island treatment plant in December 1976. Effluent from the hardboard plant was studied by the Pacific Environment Institute and the Commission, and was found to be much more toxic than specified by federal regulations or provincial objectives. Bioassays and chemical analyses showed that wood extractives, primarily neutral compounds and resin acids, were the primary cause of effluent toxicity. Chemicals derived from phenolformaldehyde glue used in forming hardboard played an insignificant role in the toxicity of wastewater. It is doubtful that the hardboard plant effluent is detoxified during passage through the Annacis Island treatment plant, since this plant is not designed to detoxify soluble substances.

Research reported in Progress Report 38 showed primary treated sewage effluent free of chlorine residual at Annacis Island treatment plant was more toxic than effluent from the other three major primary treatment plants in the Greater Vancouver area. Toxicity was equal to or greater than that reported for similar treatment plants in Seattle and San Francisco. Acute toxicity of effluent at Annacis Island was greater during dry weather than during wet weather. Dilution by stormwater was believed the cause for lower toxicity during wet weather. Further comparison showed toxicity averaged 5.9 toxic units for on-line continuous flow bioassays during dry weather, but averaged 2.9 toxic units in static bioassays of composite samples. It was considered likely that the difference in toxicity between continuous flow and static bioassays reflected temporal changes in toxicity of the sewage. Provincial objectives for municipal sewage discharges do not specify static or continuous flow bioassays as the criterion for measuring acute toxicity. However, if the more sensitive result is desired, on-line continuous flow tests would be preferred over static bioassays. Toxicity of chlorine-free effluent at Annacis Island exceeded the

Level BB objective of 1.33 toxic units specified in a Pollution Control Branch discharge permit issued in 1977. Reports in the technical literature indicate Level BB, and the higher Level AA objectives can be met by various forms of secondary treatment. The permit directed the Greater Vancouver Sewerage and Drainage District to undertake a source control program plus pilot testing of chemical, biological and other secondary treatment alternatives at Annacis Island treatment plant. A source control program was underway in 1978, but there was no report of pilot testing being conducted.

Under terms of a Pollution Control Branch discharge permit, the pulp mill at Kamloops was directed to undertake studies to reduce the amount of color discharged. Since a substantial portion of effluent color occurs in the bleaching process, technological changes were examined for a possible solution. Oxygen bleaching of pulp was tested at the pulp mill but performance was not adequate. However, study continued and additional modifications in the bleaching process were planned for testing. The mill also was directed to continue and expand a physical, chemical and biological monitoring program in Kamloops Lake, Thompson River, plus the North and South Thompson Rivers. Samples of plankton collected from Kamloops Lake by Weyerhaeuser personnel were forwarded to the Commission for measurement as in the past.

Commission staff inspected and photographed areas of the Thompson River downstream of Kamloops Lake where surveys were made previously to document the growth of benthic algae. Results ranged from slight increase to slight decrease compared to a similar inspection in 1977. Overall there was little change from 1977, but less algae than observed during 1975 when growths were abundant. In this connection the practice of adding supplemental phosphorous to pulp mill effluent to assist detoxification in the aerated lagoons was found unnecessary and ceased in 1976, and in 1976 the City of Kamloops began removing phosphorous from sewage in the municipal sewage lagoons by precipitation with alum. One lagoon is operated on a fill and drawdown basis with discharge of treated sewage during spring freshet and again in autumn when residual phosphorous is least likely to stimulate benthic algae growth. However, loss of phosphorous to the Thompson River via exfiltration at the sewage lagoons was not corrected. Owing to growth in the area, an engineering study has been authorized to examine sewage disposal options for Kamloops.

Surveys of Cultus Lake revealed that the aquatic weed, Eurasian water milfoil *(Myriophyllum spicatum),* had increased in area and density since first documented in 1977. Eurasian milfoil was found in most shoreline areas of the lake with density ranging from sparse to dense. Some Eurasian milfoil plants were noted on Lindell Beach in November adjacent to sockeye spawning grounds, but there was no evidence these interfered with spawning. Inspection of Sweltzer Creek in autumn 1978 revealed substantial growth of Eurasian milfoil along the margins and rooted sprigs on some spawning gravel. The Water Investigations Branch of the B.C. Ministry of Environment reported Eurasian milfoil in ponds, lakes and sloughs in the Fraser Valley, plus marginal areas of the Fraser River near Chilliwack. To control Eurasian milfoil in Cultus Lake, a local ad hoc committee arranged for a diver-operated suction dredging program in October 1978 to remove plants and roots. Areas dredged were selected to interrupt spread of Eurasian milfoil toward the south end of Cultus Lake while avoiding spawning grounds. Measurements by the Commission showed turbidity was not affected by suction dredging. The committee proposed to continue dredging in 1979 and also proposed that herbicide be applied in selected areas. The

Commission will examine these proposals and make recommendations to protect sockeye and pink salmon. Research was conducted at Sweltzer Creek Laboratory in 1978 to measure the toxicity to eggs, fry and smolts of Aqua Kleen 20, a clay granule impregnated with herbicide used to kill Eurasian milfoil. The herbicide is the butoxyethyl ester (BEE) of 2,4-D. This chemical is unstable in water and hydrolyzes to the less toxic 2, 4-D acid at a rate which decreases with decrease in pH and temperature. It is important, therefore, that the rate of release of the chemical, and water temperature and pH be taken into account when considering possible use of the herbicide in sockeye rearing lakes such as Cultus Lake.

The Commission participated with the Fisheries Service in an interagency committee formed in October 1977 to review drainage plans for the Hemlock Valley ski resort development to minimize potential effects on the Weaver Creek spawning channel and natural spawning grounds. The resort is at the headwaters of Sakwi Creek, a tributary of Weaver Creek at the sockeye spawning area. Part of the water supply for the spawning channel also is obtained from Sakwi Creek near its junction with Weaver Creek. As a consequence of observed siltation in Sakwi Creek, the fisheries agencies recommended in December 1977 that plans for subdividing additional area in 1978 be delayed until siltation problems were corrected by an acceptable drainage plan. However, expansion was authorized by the B.C. Land Management Branch and the proponents produced a conceptual plan for drainage control. In the interest of protecting the salmon resource, the Commission and Fisheries Service recommended to the Land Management Branch that certain principles, procedures, design criteria and timing constraints be followed in designing and constructing drainage works. The fisheries agencies recognized that siltation of Sakwi Creek would occur during construction and therefore recommended work be completed by mid August to permit stabilization of disturbed areas before spawning salmon arrived in Weaver Creek. The Land Management Branch formulated guidelines for the work to be done. Monitoring confirmed that construction activities and disturbed soil were a source of silt during the summer construction period authorized by the guidelines. Monitoring in autumn 1978, after construction ceased, revealed the impact which development at the ski resort can have upon turbidity downstream in Sakwi Creek at the diversion to the spawning channel. With rainfall of 4.5 and 4.1 cm on November 6 and 7 at Hemlock Valley, Sakwi Creek had a turbidity of 580 Nephelometric Turbidity Units (NTU) on November 7 at the exit from the resort area, and at the Commission's water intake downstream, turbidity increased from 103 to 665 NTU during the day. These values are equal to or higher than the suspended sediment load of the Fraser River during the summer freshet, and if continued or repeated a number of times during the period of egg incubation, would reduce significantly the survival of the eggs to fry.[1] The severe silting and erosion that occurred in Weaver Creek during the flood in November 1977 reduced the sockeye survival from eggs to fry to only 0.73%. The estimated fry production from the creek in the spring of 1978 was 340,000 sockeye and 99% of this production came from above the confluence with Sakwi Creek.

A Pollution Control Branch discharge permit specifies that final disposal of treated sewage from the resort at Hemlock Valley shall be outside the Sakwi Creek drainage. To satisfy this requirement a sewage pipeline to Maisal Creek in the Chehalis River drainage was installed and a sewage treatment plant, was nearly complete in

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[1] The Effect of Transported Stream Sediments on the Survival of Sockeye and Pink Salmon Eggs and Alevin. A.C. Cooper. Int. Pac. Salmon Fish. Comm. Bull. XVIII. 1965. 69 p.

1978. Pending completion of the treatment plant, sewage was removed to a municipal sewage treatment plant in Agassiz by tank truck.

Potential effects of acid precipitation from a coal-fired thermal power plant proposed for Hat Creek by B.C. Hydro was the subject of a review by an ad hoc committee in 1977. The review recommended a monitoring program to include chemical measurements of precipitation and surface waters. However, sampling to establish baseline water quality was delayed by B.C. Hydro until approval for the power project is sought.

In response to proposals for a larger logging area, the Commission expanded its water quality sampling program in the Nadina area to include tributaries to Nadina Lake. Turbidity was commonly low in tributaries to Nadina River originating in undisturbed areas in spite of rain or spring freshet. However, sediment laden runoff was documented in two tributaries receiving runoff from construction of logging roads. Logging plans are reviewed by the Commission in cooperation with Fisheries Service and the B.C. Forest Service, and recommendations are made to minimize adverse impacts on the Nadina River.

Measurements of turbidity, pH and conductivity of the Fraser River at Hell's Gate were continued.

ENGINEERING

Repairs to the Weaver Creek spawning channel as well as restoration of Weaver Creek and Sakwi Creek following the flood in November 1977 were completed during 1978. The total cost of these repairs, including the cleaning of the gravel in the spawning channel, was $74,000 including the work done immediately after the flood, as described in the 1977 Annual Report. Early in 1978 the main channel of Weaver Creek downstream from the channel was dry and large deposits of bed materials were exposed. The low flow in the creek was passing beneath these deposits or out of the main channel through the adjacent low lands, and checks within these deposits showed there were no live eggs remaining. Some of the material was removed to restore the main creek channel before the spring runoff. Some additional channeling was done in Weaver Creek between the spawning channel fish entrance and the confluence with Sakwi Creek during the summer dry season after all fry had left the stream. The spawning channel gravel was cleaned during the summer using the cleaner developed by the Commission. Because of the excessive quantities of silt, which accumulated downstream from the cleaner as it progressed, much of the material had to be removed by machine and trucked from the site. Sand and gravel deposited in Sakwi Creek at the water diversion intake was removed late in the summer and the grouted rock intake diversion weir was repaired.

A further flood in November 1978 after completion of sockeye spawning was relatively minor compared to the 1977 flood, but a large volume of sand and gravel was again carried down Sakwi Creek and deposited in the lower portion of the stream, causing restriction of the flood-carrying capacity and again washing out the diversion weir at the water intake on Sakwi Creek. Emergency work was done immediately but additional work in the stream will be required in 1979 to again rebuild the water intake and to restore the flood-carrying capacity of Sakwi Creek.

The fish sorter in the Weaver spawning channel described in the 1977 Annual Report proved again to be an effective method for separating sockeye and chum entering the channel. The pressure of the increasing numbers of returning chum salmon has resulted in some of these fish entering Sakwi Creek and attempting to spawn in the limited and unstable gravel area. Although there is no record of chum salmon utilizing this area in previous years, it will now be necessary to provide fish passage at the intake weir to give access to the stream bed upstream.

Emergency repairs were also required at the Hell's Gate left bank low level fishway. Erosion damage to the concrete floor of the fishway had weakened the structure by wearing the concrete to such an extent that much of the reinforcing steel was exposed. Because the repair work could be done for only a short period in the spring after melting of winter ice and before the spring rise in water level, a helicopter was used for transporting and placing new concrete.

In cooperation with the Fisheries Service, accumulations of timber debris in the lower part of Adams River were removed just prior to the arrival of this year's large spawning population.

Logging activities adjacent to and in the headwaters of sockeye spawning streams are of major concern because of potential adverse effects on the fishery resource as a consequence of changes in water quality and stream and lake habitat. Particular concerns have been expressed about effects of logging of the Nadina, Horsefly and Upper Adams Rivers watersheds. Greatest effort to date has been directed toward protection of the Nadina watershed in view of the vulnerability of the Early and Late Nadina populations, which together have a large potential for increasing production of Fraser River sockeye. In collaboration with the Fisheries Service, meetings are regularly held with B.C. Forest Service, other resource agencies and the forestry companies to encourage the use of planning and implementation procedures that will ensure protection of sockeye.

In the Horsefly River system, logging has been underway for several years and a continuing effort is required for protecting water quality in this very important sockeye producing area. Plans for increased logging activity in Upper Adams River watershed have also been discussed with B.C. Forest Service. Although attempts to reestablish this formerly important sockeye producing area have not yet been successful, every effort must be made to protect the spawning area, which will be required for utilization of the sockeye producing potential of Adams Lake.

Dredging and dyke reconstruction in the Vedder River in 1976 followed a severe flood in December 1975 and since that time studies have been conducted to observe the effects on pink salmon spawning. As a result of the 1975 flood there was a marked reduction in the 1977 pink salmon spawning population and a smaller proportion of the run (30%) spawned downstream from Vedder Crossing than in 1975 (50%). In the upriver spawning area, hydraulic sampling early in 1978 recovered an average of 95 live alevins per sq ft, whereas below Vedder Crossing the recoveries ranged from zero to 12.9 alevins per sq ft. Construction of the proposed set-back dykes, which will reduce the need for instream dredging, has not yet started but the lands on which the dykes will be built are being acquired by the provincial government.

Studies were made during the 1977-78 period of pink salmon spawning and

incubation in the main stem of the Fraser River between Sumas River and Ruby Creek where dredging is done to permit towing of log booms. The studies confirmed that the areas where dredging is done are used for spawning by pink salmon and that pink salmon eggs and alevins survive in these areas despite very high river velocities.

Several meetings were held in 1978 with provincial government agencies and their consultants concerning proposals to provide bank protection in Lillooet and Birkenhead Rivers, both of which are used by spawning sockeye. Meetings were also held with B.C. Hydro and its consultants concerning investigation of a geothermal power development in the headwaters of Lillooet River. Construction of a new highway between Hope and Merritt could cause downstream siltation on pink salmon spawning grounds in Coquihalla and Nicola Rivers. However, all contracts on the project will be subject to special conditions for protection of the environment.

In addition to the Hemlock Valley recreational development at the headwaters of Sakwi Creek described earlier, another recreational subdivision is being planned near the Weaver spawning channel. Discussions have also been held concerning proposed property developments adjacent to spawning grounds on the Coquihalla and Seymour Rivers. The Adams River spawning grounds have now been protected from such encroachment with the establishment of the Roderick L. Haig-Brown Conservation Area along the entire length of this river.

Discussions have been held with environmental consultants to the Department of Public Works of Canada to determine possible effects of a proposed navigation improvement works in the lower Fraser River. The consultant is examining the possible effect of the scheme on fish, including effects on the migration and rearing of sockeye and pink salmon.

B.C. Hydro announced in 1978 that plans for power development on MacGregor River had been postponed. This proposal involved diversion of the MacGregor River from the Fraser system to the Peace River system. B.C. Hydro is still studying the feasibility of the proposed Hat Creek thermal power development and the Aluminum Company of Canada is updating information concerning the feasibility of developing the remaining power potential of Nechako River.

In conjunction with B.C. Hydro and Power Authority, studies continued at the Seton Creek hydroelectric project into means of alleviating or eliminating the losses of sockeye during upstream and downstream migrations past the project. These studies are being initiated and financed by B.C. Hydro as a result of earlier recommendations by the Commission and Fisheries Service. It was found that overall smolt mortality, based on rates measured by the Commission in 1957, could be reduced by diverting smolts through the spillways at Seton Dam. However, to effect significant diversion of smolts, the spill discharge during peak periods of migration had to be increased from 200 to 700 cfs. Shutting the turbine down during the peak daily period of smolt migration appeared to deter the migration of smolts out of Seton Lake.

In connection with investigations of the delay and loss of migrating adult sockeye in the tailrace of the Seton Creek hydroelectric plant, B.C. Hydro constructed a channel across the gravel bar in the Fraser River upstream from the tailrace to test the hydraulic and sedimentation problems associated with such a channel. The investigation showed that the channel was effective for diverting Seton Creek water

out of the Fraser River. The low Fraser River peak discharge in 1978, however, provided only minimal sedimentation information. The channel was deepened during the Portage Creek migration and the attractiveness of the channel to migrating sockeye was established. The behavior of migrating Portage Creek sockeye in response to various plant operating conditions and spill discharges was studied using radio-telemetry techniques. Miniature radio transmitters were inserted internally into 30 fish and their migration movements were charted. Results indicated that dilution of Seton Creek by its tributary, Cayoosh Creek, may significantly reduce the attractiveness of Seton Creek to sockeye in comparison with the attractiveness of the pure Seton Lake water discharged from the powerhouse. It was found that sockeye that had been delayed in the tailrace of the powerhouse made repeated exits from the tailrace. They approached Seton Creek but did not enter it if the ratio of Seton to Cayoosh water was low. It was also determined that fish that had been delayed for several days in the tailrace required a higher spill discharge and higher Seton to Cayoosh water ratio for successful migration than did undelayed fish. Information obtained in 1978 further confirms the need for a method of providing undelayed passage for sockeye from the tailrace to Seton Creek.

TABLE I

SOCKEYE CATCH BY GEAR

Gear		1966	1970	1974	1978
United States Convention Waters					
Purse Seines	Units	187	191	272	165
	Catch	783,466	779,271	1,515,444	694,460
	Percent	58.59	57.72	61.56	50.97
Gill Nets	Units	384	492	1,140	999
	Catch	496,295	504,873	873,595	635,795
	Percent	37.11	37.39	35.49	46.67
Reef Nets	Units	40	41	54	43
	Catch	57,086	65,644	72,408	31,832
	Percent	4.27	4.86	2.94	2.34
Troll	Catch	368	429	228	359
	Percent	0.03	0.03	0.01	0.03
TOTAL CATCH		1,337,215	1,350,217	2,461,675	1,362,446
Canadian Convention Waters					
Purse Seines	Units	77	87	202	46
	Catch	405,585	441,120	1,044,742	460,603
	Percent	30.04	28.61	41.79	34.97
Gill Nets	Units	1,484	1,263	1,000	1,199
	Catch	922,831	955,178	1,029,678	626,506
	Percent	68.35	61.95	41.19	47.57
Troll	Catch	21,738	145,473	425,599	230,006
	Percent	1.61	9.44	17.02	17.46
TOTAL CATCH		1,350,154	1,541,771	2,500,019	1,317,115

NOTE: Gear counts represent the maximum number of units delivering sockeye on a single day near the peak of the run.

TABLE II

CYCLIC LANDINGS OF SOCKEYE FROM CONVENTION WATERS

	United States	*Canada*	*Total*
1978			
Total Landings (No. Sockeye)	1,362,446	1,317,115	2,679,561
Share in Fish	50.85%	49.15%	
1946-1978			
Total Landings (No. Sockeye)	55,269,145	54,249,601	109,518,746
Share in Fish	50.47%	49.53%	
1978 *Cycle Catch*			
1978	1,362,446	1,317,115	2,679,561
1974	2,461,675	2,500,019	4,961,694
1970	1,350,217	1,541,771	2,891,988
1966	1,337,215	1,350,154	2,687,369
1962	758,637	836,399	1,595,036
1958	5,257,316	5,241,617	10,498,933
1954	4,806,258	4,722,463	9,528,721
1950	1,220,893	894,469	2,115,362
1946	3,551,310	4,240,198	7.791,508
1942	2,935,192	5,047,599	7,982,791
1938	1,408,361	1,900,220	3,308,581
1934	3,590,058	1,430,300	5,020,358
1930	3,544,718	1,043,318	4,588,032
1926	469,900	912,566	1,382,466
1922	513,848	580,144	1,093,992
1918	569,094	242,275	811,369
1914	3,555,890	2,137,177	5,693,067
1910	2,765,726	1,690,091	4,455,817
1906	2,030,550	2,066,604	4,097,154
1902	4,001,717	3,177,538	7,179,255

TABLE III

DAILY CATCH OF SOCKEYE, 1966-1970-1974-1978 FROM UNITED STATES CONVENTION WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1966	**1970**	**1974**	**1978**	**1966**	**1970**	**1974**	**1978**	**1966**	**1970**	**1974**	**1978**
1	CLOSED				131,250			57,144		31		
2					104,089					6		
3					104,338	79,718					55,431	
4					56,763	43,413						
5					73,479	35,355			8,986			
6									4,292			
7							234,490		9,196	549		
8					76,199		142,942		4,756	301		
9					66,840					671	12,421	
10					40,168	70,672				275	6,988	
11	2,317				45,066	55,718					5,044	36,666
12	1,968				51,407	59,364	105,239		3,262			11,759
13		4,133			26,894	67,530	139,059	33,751	980			5,670
14		1,716				48,662	103,232	77,453	1,686	11,940		
15			8,175		44,307		154,957	63,511	511	2,356		
16			1,776	2,124	43,556	67,087		17,125		1,373	11,730	
17				10,355	51,893	89,253				168	4,321	
18	6,902			8,379	22,143	94,580				1,722	1,450	22,278
19	6,154				17,494	73,372			8,131			8,135
20		14,399				52,020	310,026	16,556	11,012			3,014
21		10,630					216,732	354,173	12,804	792		
22		14,252	4,661		73,061		158,644	184,516	6,364	258		
23		9,783	3,997	6,245	94,884			163,430		2,634	1,442	
24				22,694				20,481		3,842	504	
25	28,951			15,825						802	262	2,030
26	34,784						308,214		145			3,080
27	41,679	47,077				234,354	238,166	48,944	186			5,341
28		33,591				91,263		138,993	33	1,305		
29		11,710	100,429						8	1,094		
30			75,587		11,044				30	923		
31			55,127	13,705	6,457	49						
Totals	122,755	147,291	249,752	79,327	1,141,332	1,162,410	2,111,701	1,176,077	72,382	31,042	99,593	97,973
Troll	75	57	133	286	287	365	87	48		1	1	
Monthly Totals	122,830	147,348	249,885	79,613	1,141,619	1,162,775	2,111,788	1,176,125	72,382	31,043	99,594	97,973
June Oct. & Nov. Totals									384	9,051	408	8,735
Season Totals									1,337,215	1,350,217	2,461,675	1,362,446

TABLE IV

DAILY CATCH OF SOCKEYE, 1966-1970-1974-1978 FROM CANADIAN CONVENTION WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1966	1970	1974	1978	1966	1970	1974	1978	1966	1970	1974	1978
1					227,815			47,145		933	13,378	
2			14,984		102,476			39,809		167,484	9,823	
3					44,215	84,815					79,914	
4	9,042				48,348	133,926						
5	9,990						64,383		438			108,180
6									6,858			
7					134,957		194,503		174	107		
8			29,177		81,319		180,367	71,632	105	5,627		
9			5,701		57,790					61	112,839	
10			9,000		76,573						1,271	32,682
11	9,714				55,376	231,605				8,248		
12	2,539				102,303	185,031			174	105		23,715
13		5,562							16	139	135,407	
14								87,122	511	239		
15			7,754	Strike	46,027		32,131					
16				July 16-19	45,504						1,405	
17				4,997	48,046	94,112					1,712	
18	8,073					103,304	147,866					3,633
19	5,050						113,219		760			
20		9,883					199,353		71			
21		5,225						216,090	903			
22			4,838		70,477			122,905				
23			3,328		48,119			124,712				
24				14,087								
25	40,159			6,736			34,766					
26	15,177						88,440		530			
27		71,450				27,577	33,882		56			
28		45,779				4,850	235,993	83,743	7,668	150,254		64,897
29		21,227	84,653									
30			94,877		1,689						26,041	
31			103,943		7,233	1,975						
Totals	99,744	159,126	358,255	25,820	1,197,267	867,195	1,324,903	793,158	18,264	333,197	381,790	233,107
Troll	2,603	11,353	49,208	9,251	18,950	134,009	368,553	214,652	35	51	7,814	6,103
Spring Salmon Gill Nets		1,025		2,142	2,970	5,222			3,810			
Monthly Totals	102,347	171,504	407,463	37,213	1,219,187	1,006,426	1,693,456	1,007,810	22,109	333,248	389,604	239,210
June, Oct. & Nov. Totals									6,511	30,593	9,496	32,882
Season Totals									1,350,154	1,541,771	2,500,019	1,317,115

TABLE V

INDIAN CATCH OF SOCKEYE BY DISTRICT AND AREA, 1974 AND 1978

	1974		1978	
District and Area	*Catch*	*No. of Fishermen**	*Catch*	*No. of Fishermen**
HARRISON-BIRKENHEAD				
Birkenhead River and Lillooet Lake	11,550	16	14,910	1
TOTALS	11,550	16	14,910	1
LOWER FRASER				
Below Hope	71,894	155	84,349	515
TOTALS	71,894	155	84,349	515
MIDDLE FRASER				
Hope to Lytton	69,975	436	70,755	495
Lytton to Churn Creek	36,275	625	24,015	555
TOTALS	106,250	1,061	94,770	1,050
CHILCOTIN				
Farwell Canyon to Siwash Bridge	5,506	137	6,889	108
Keighley Holes	1,350		1,561	
TOTALS	6,856	137	8,450	108
UPPER FRASER				
Churn Creek to Quesnel	3,905	163	4,588	176
Shelley	366	24	704	33
TOTALS	4,271	187	5,292	209
NECHAKO				
Nautley and Stella Reserves	4,328	40	6,236	94
TOTALS	4,328	40	6,236	94
STUART				
Fort St. James-Pinchi Village	1,890	39	3,293	51
Tachie, Takla and Trembleur Villages	2,018	63	3,836	79
TOTALS	3,908	102	7,129	130
THOMPSON				
Main Thompson	11,150	153	14,250	484
North Thompson	30	2	—	—
South Thompson	1,820	178	—	—
TOTALS	13,000	333	14,250	484
GRAND TOTALS	222,057	2,031	235,386	2,591

*Number of permits issued to Indians in district.

The Indian catch statistics detailed above are obtained from the Canada Department of the Environment, Fisheries Service. Their officers control the taking of sockeye by the Indian populations residing throughout the Fraser River watershed.

TABLE VI

SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1966, 1970, 1974, 1978

District and Streams	1978 Period of Peak Spawning	Estimated Number of Sockeye					Sex Ratio	
		1966*	1970*	1974*	1978	Jacks	Males 4-5 Yr.	Females 4-5 Yr.
LOWER FRASER								
Cultus Lake	Nov. 13-17	17,464	15,149	9,814	7,265	2,189	1,920	3,156
Upper Pitt River	Sept. 12-16	20,867	6,657	20,792	24,835	49	10,609	14,177
Widgeon Slough	Sept. 4-8	884	364	1,643	1,600	26	618	956
HARRISON								
Big Silver Creek	Sept. 25-27	329	261	837	1,253	0	559	694
Harrison River	Nov. 10-15	32,672	12,675	16,920	19,747	30	9,196	10,521
Weaver Creek	Oct. 27-Nov. 1	13,875	6,373	42,143	43,989	762	17,739	25,488
Weaver Channel	Oct. 17-22	6,541	4,723	24,664	32,248	304	14,417	17,527
LILLOOET								
Birkenhead River	Sept. 26-29	81,134	72,760	173,463	99,857	5,075	46,382	48,400
SETON-ANDERSON								
Gates Creek	Sept. 14-18	592	68	146	931	820	44	67
Gates Channel	Sept. 14-18	—	735	1,645	1,639	1,492	43	104
Portage Creek	Nov. 12-15	31,844	3,901	8,986	10,230	252	5,793	4,185
SOUTH THOMPSON								
Seymour River	Sept. 1-5	28,754	11,991	45,189	62,929	121	31,955	30,853
Eagle River	Sept. 13-17	288	23	263	189	0	96	93
Scotch Creek	Sept. 1-4	459	304	464	2,056	0	881	1,175
Anstey River	Aug. 30-Sept. 1	—	196	666	886	2	450	434
Upper Adams River	—	63	4	13	0	0	0	0
Lower Adams River	Oct. 22-25	1,197,336	1,297,990	889,613	1,493,473	2,135	687,554	803,784
Little River	Oct. 25-27	55,952	168,881	122,112	81,055	632	30,406	50,017
South Thompson River	Oct. 25-27	4,313	5,931	14,466	9,986	57	3,749	6,180
Lower Shuswap River	Oct. 19-20	24,629	29,074	86,396	187,167	33	96,346	90,788
Middle Shuswap River	Oct. 19-20	1,872	4,559	3,064	10,890	0	4,969	5,921
Misc. Late Runs	Oct. 25-27	38,378	50,389	41,882	117,832	193	54,159	63,480
NORTH THOMPSON								
Raft River	Sept. 5-8	6,250	4,474	2,396	2,500	7	1,150	1,343
Fennell Creek	Aug. 29-Sept. 2	—	9	243	675	568	53	54
North Thompson River	—	46	270	343	—			
CHILCOTIN								
Chilko River	Sept. 26-29	226,702	145,049	128,131	151,835	8,433	60,269	83,133
Chilko Lake-South End	Sept. 10-15	—	0	14,464	7,339	3,899	596	2,844
QUESNEL								
Horsefly River	Sept. 4-10	1,607	1,350	4,459	7,287	0	3,552	3,735
Mitchell River	Sept. 15-18	142	23	—	1,237	0	599	638
NECHAKO								
Nadina River (Early)	—	83	78	0	0	0	0	0
(Late)	Sept. 20-23	1,784	3,939	2,930	227	16	85	126
Nadina Channel	Sept. 18-21	—	—	895	2,555	182	958	1,415
Stellako River	Sept. 24-30	101,684	45,876	41,473	60,421	1,523	25,498	33,400
STUART								
Early Runs								
Ankwill Creek	July 29-30	86	220	544	1,363	0	602	761
Bivouac Creek	July 29-30	0	0	40	157	0	69	88
Crow Creek	July 29-30	126	396	981	467	0	206	261
Driftwood River	July 31-Aug. 1	140	1,983	1,894	4,903	0	2,206	2,697
Dust Creek	July 29-30	178	963	934	657	0	290	367
Felix Creek	July 28-29	979	2,866	3,201	5,575	0	2,410	3,165
Fleming Creek	July 28-29	0	106	20	590	0	234	356
Forfar Creek	July 29-30	1,739	6,476	5,495	9,579	22	4,218	5,339
Forsythe Creek	July 29-30	67	187	270	381	0	168	213
Frypan Creek	July 29-30	58	130	362	448	0	198	250
Gluske Creek	July 29-30	1,876	5,702	5,548	4,295	2	1,895	2,398
Kynoch Creek	July 29-30	3,591	4,676	10,652	10,649	43	4,681	5,925
Leo Creek	July 29-30	0	41	32	34	0	15	19
Narrows Creek	July 31-Aug. 1	322	144	486	709	3	312	394
Paula Creek	July 28-29	0	565	2,059	1,604	4	722	878
Rossette Creek	July 29-30	1,645	7,664	5,675	7,452	19	3,281	4,152
Sakeniche River	July 30-31	2	0	51	123	0	54	69
Sandpoint Creek	July 29-30	0	358	599	493	0	218	275
Shale Creek	July 29-30	50	34	345	470	0	207	263
Misc. Streams	July 28-30	0	236	456	148	0	66	82
Early Stuart Totals	July 28-Aug. 1	(10,859)	(32,747)	(39,644)	(50,097)	(93)	(22,052)	(27,952)
Late Runs								
Kazchek Creek	—	144	74	239	122	3	53	66
Kuzkwa Creek	Sept. 21	295	90	718	742	16	320	406
Middle River	Sept. 21-25	4,917	12,115	8,990	4,061	90	1,753	2,218
Pinchi Creek	Sept. 21	76	0	0	74	2	32	40
Tachie River	Sept. 21-25	3,600	2,776	4,680	8,028	178	3,465	4,385
Late Stuart Totals	Sept. 21-25	(9,032)	(15,055)	(14,627)	(13,027)	(289)	(5,623)	(7,115)
NORTHEAST								
Upper Bowron River	Aug. 27-30	2,480	1,341	1,850	3,150	9	1,240	1,901
TOTALS**		1,919,286	1,943,221	1,757,474	2,514,318	29,513	1,141,159	1,343,646

*Numbers for some populations are revised from the Annual Report for the respective years.
**Totals include small numbers of fish in small tributaries not listed in the table.

TABLE VII

DAILY CATCH OF SOCKEYE, 1963-1967-1971-1975 FROM UNITED STATES CONVENTION WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1963	1967	1971	1975	1963	1967	1971	1975	1963	1967	1971	1975
1.			1,068		112,848	83,010	9,704			17,852	79,685	
2.					72,265	94,322	145,517		1,282		60,079	12,595
3.							94,802		1,032		87,853	
4.							53,159		47		56,222	
5.	CLOSED		12,708		81,546				10	11,025	1,411	
6.			8,111		48,585	5,594				11,025	87,582	
7.			9,281	72,530	29,274	88,268				6,254	69,145	
8.			4,588	27,405	18,439	58,194	7,447				33,948	866
9.		251		20,843			155,896		28			683
10.		4,465					88,141		439			
11.		3,762	1,714				58,076	194,558	421	2,548		
12.			20,210		37,789		39,934	124,550		7,379		
13.			17,672		12,228	152,217				4,728		
14.			15,708	31,499	14,300	115,530	4,037	111,121		1,982	281	249
15.			9,213	12,561		104,995	109,435				4,431	152
16.		1,145				64,753	113,464				3,305	113
17.		16,742					104,877				1,891	
18.		12,781	6,773				108,613	99,033	32	2,631		
19.			56,405		6,193		76,550	80,684	6	604	175	
20.			45,037		4,269		50,385	42,852		515	1,163	
21.			37,835	103,060	2,680	189,061	547			198	980	
22.	33,394			73,338		197,978	112,368				594	
23.	110,105	5,072				156,371	93,858					139
24.	130,412	103,996				108,378	86,382					111
25.	94,278	74,382	16,459				55,063			11		
26.	92,026	67,596	105,003		2,648		19,109	37,880		9	7	
27.	61,186	54,405	72,329		2,686			18,493		6	396	
28.			85,289	187,942	2,330						116	
29.	114,620		89,638	122,179	151	41,810					64	18
30.	121,644	6,455		93,726		27,915	6,599		19		38	13
31.	104,333	146,028		91,233		31,254	94,802					
Totals	861,998	497,080	615,041	836,316	448,231	1,519,650	1,688,765	709,171	3,316	66,767	489,366	14,939
Troll	240	143	122	189	203	34	190	316	1		6	8
Monthly Totals	862,238	497,223	615,163	836,505	448,434	1,519,684	1,688,955	709,487	3,317	66,767	489,372	14,947
June, Oct. and Nov. Totals									56	4,152	22,639	2,912
Season Totals									1,314,045	2,087,826	2,816,129	1,563,851

TABLE VIII

DAILY CATCH OF SOCKEYE, 1963-1967-1971-1975 FROM CANADIAN CONVENTION WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1963	1967	1971	1975	1963	1967	1971	1975	1963	1967	1971	1975
1			231			19,223	114,248				19,968	232
2			Strike			16,577	189,823		11,459		34,675	28,563
3			June 26-				113,015		8,062	2,170	124,765	
4			July 10		91,288			50,455	10,160	29,490	16,483	
5			953		70,820			40,096	106	27,699	20,106	11,838
6			915		54,485	73,831				476	50,720	597
7	CLOSED		850	36,951	44,820	184,860				639		454
8			874		9,987	89,770				441	40,196	40,283
9				8,136		114,059	288,641		15,879		46,210	
10							188,407	6,174	57		36,579	
11			39,111				198,973	4,731	12	55,886	32,316	
12			16,037		59,034			11,665		37,370	27,253	
13					27,942			10,241		793	3,514	
14				30,328	8,205	183,161				318	18,537	7,177
15			12,044		5,783	129,684					18,225	223
16	784					104,460	190,798		4			131
17	1,503	10,864					87,209		2			43
18		8,744						25,011		650		12,914
19		6,984	21,756		43,585			9,082		371		
20			13,361		13,553			8,015		208	391	
21				26,256	3,146	115,565		7,752			167	
22	3,757			17,519	3,979	76,188	60,261	3,278		50,985	16,238	6,173
23	6,900				1,955	36,132	86,106		15,557		7,811	66
24	22,877	47,625					16,933					
25	Strike	21,971		Strike				40,306	6	234		3,254
26	July 12-	27,672	187,654	July 25-	11,487		142,151	18,025	0	115	22,579	
27	Aug. 4	26,691	40,513	Aug. 24	15,577		100,315	2,516		108	2,315	
28			18,266	25,123	1,175	66,008						
29	19,241			13,201	1,276	24,586					6,281	3,378
30	21,981				590	5,799	173,063				2,812	13
31	47,394	92,491				4,370	54,019					
Totals	124,437	243,042	352,565	157,514	468,687	1,244,273	2,003,962	237,347	61,304	207,953	548,141	115,339
Troll	1,673	32,565	21,857	2,145	5,028	125,490	166,518	41,800	3,057	3,470	2,460	6,337
Spring Salmon Gill Nets	732	1,142	617						618		4,786	3,571
Monthly Totals	126,842	276,749	375,039	159,659	473,715	1,369,763	2,170,480	279,147	64,979	211,423	555,387	125,247
April, June, Oct. and Nov. Totals									21,145	17,547	13,392	80,420
Season Totals									686,681	1,875,482	3,114,298	644,473

TABLE IX

SUMMARY OF THE SOCKEYE ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS, 1963, 1967, 1971, 1975

District and Streams	1975 Period of Peak Spawning	Estimated Number of Sockeye			
		1963*	1967*	1971*	1975*
LOWER FRASER					
Cultus Lake	Nov. 15-20	20,571	33,492	9,145	11,478
Upper Pitt River	Sept. 13-16	12,680	10,300	15,469	39,942
Widgeon Slough	Nov. 11-13	353	1,006	394	936
HARRISON					
Big Silver Creek	Sept. 25	74	0	0	31
Harrison River	Nov. 13-20	22,287	20,577	3,790	5,987
Weaver Creek	Oct. 21-26	14,469	19,730	2,887	12,195
Weaver Channel	Oct. 16-20	—	2,887	2,736	19,816
LILLOOET					
Birkenhead River	Sept. 23-28	67,151	58,036	32,672	92,928
SETON-ANDERSON					
Gates Creek	Sept. 7-12	4,858	1,665	797	788
Gates Channel	Aug. 27-Sept. 2	—	—	1,502	3,768
Portage Creek	Nov. 1-5	2,011	4,048	281	3,829
SOUTH THOMPSON					
Seymour River	Aug. 28-Sept. 1	71,690	13,361	19,028	37,024
Upper Adams River	Aug. 28-Sept. 1	5	—	0	23
Lower Adams River	Oct. 12-17	154,086	755,238	280,176	148,187
Little River	Oct. 12-17	2,436	74,490	2,821	7,268
South Thompson River	Oct. 12-17	45	270	10	16
Lower Shuswap River	Oct. 10-15	7,379	5,951	6,117	11,652
Misc. Late Runs	Oct. 10-28	7	9,981	1,169	1,442
NORTH THOMPSON					
Raft River	Sept. 8-12	8,724	1,303	840	2,664
Barriere River	—	92	16	5	0
Fennell Creek	Aug. 19-23	439	920	1,300	4,127
North Thompson River	—	70	—	888	123
CHILCOTIN					
Chilko River	Sept. 22-27	1,002,252	176,337	161,943	220,554
Chilko Lake South End	Sept. 9-15	—	—	12,323	55,144
Taseko Lake	Aug. 29-Sept. 2	31,667	5,700	10,500	4,394
QUESNEL					
Horsefly River	Aug. 30-Sept. 2	86	119	171	101
Upper McKinley River	—	—	—	—	100
NECHAKO					
Endako River	—	2,540	949	284	192
Nadina River (Early)	Aug. 28-Sept. 1	1,019	1,595	1,222	481
(Late)	Sept. 18-20	7,304	7,790	14,525	4,013
Nadina Channel (Late)	Sept. 17-20	—	—	—	11,306
Nithi River	—	763	1,688	1,796	1,144
Ormonde Creek	—	41	0	0	0
Stellako River	Sept. 29-Oct. 5	138,805	91,525	39,726	176,079
STUART					
Early Runs					
Driftwood River	Aug. 8	14	52	335	20
Forfar Creek	Aug. 3-5	652	4,815	25,178	6,818
Gluske Creek	Aug. 5-7	0	1,368	14,305	10,370
Kynoch Creek	Aug. 5-7	2,147	6,694	22,932	25,124
Narrows Creek	Aug. 5-7	180	454	3,467	1,704
Rossette Creek	Aug. 1-4	1,600	6,566	16,454	8,543
Misc. Streams	Aug. 1-7	35	1,120	13,271	13,188
Late Runs					
Kazchek Creek	—	364	92	40	—
Middle River	Sept. 18-22	1,838	972	873	6,704
Tachie River	Sept. 18-22	1,035	576	360	7,525
NORTHEAST					
Upper Bowron River	Aug. 27-30	25,144	31,695	25,497	29,700
TOTALS**		1,606,924	1,353,640	747,523	990,716

*Numbers for some populations have been revised from the respective Annual Reports.
**Totals include small numbers of fish in small tributaries not listed in the table.

TABLE X

DAILY CATCH OF PINK SALMON, 1971-1973-1975-1977 FROM UNITED STATES CONVENTION WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1971	1973	1975	1977	1971	1973	1975	1977	1971	1973	1975	1977
1	1				240	4,907		1,040	78,550	360,059		17,172
2		100			4,882				90,063	330,814	280,698	
3		140			3,215				201,457	206,254		
4		152			1,946				189,407			1,641
5	9			220					4,666			152,848
6	9			203				854	328,841			10,868
7	20		307	71				8,841	390,632			
8	4		308	189	55	14,294		109	262,261		53,910	
9		1,067	324		7,185			8,300		294,472	32,018	
10		1,496			7,161			644		169,530		
11	1	2,615			5,042		19,933			66,887		
12	43	3,581			4,649		16,127					219
13	62	3,818										
14	111		1,066	1,776	344	22,253	23,762	1,796	6,114		146,806	
15	67		840	409	7,238	15,311		46,828	144,795		132,744	
16		5,661			7,552			70,333	121,411		57,264	5,344
17		3,799			6,577				91,232	59,485		55
18	34	2,908			6,006		55,608			21,161		
19	563				5,056		52,909		11,796			36
20	514				3,154	62,583	53,815		59,887			2,042
21	732		8,328		45	59,992		23,559	59,521			1,623
22			5,047		7,257	43,693		446,813	33,525			995
23		6,729			9,171	20,293		246,590			12,387	
24		5,110		2,163	12,231			275,569		6,891	4,707	
25	112	4,251		4,015	13,107			21,322		3,242		
26	2,033			1,363	11,680		137,643	20,728	1,212			743
27	1,438					249,269	91,649		19,789			780
28	2,391		12,707			138,583			6,741			243
29	2,837		8,891					9,689	7,948		2,431	
30		6,821	7,998	422	5,580			360,684	6,865		866	
31		5,114	8,130	4,657	92,273			250,303				
Totals	10,981	53,362	53,946	15,488	221,646	631,178	451,446	1,794,002	2,116,713	1,518,795	723,831	194,609
Troll	1,999	7,108	7,881	40,202	8,154	5,704	11,946	118,162	1,859	598	956	4,394
Monthly Totals	12,980	60,470	61,827	55,690	229,800	636,882	463,392	1,912,164	2,118,572	1,519,393	724,787	199,003
June, Oct. & Nov. Totals									9,799	8,179	3,149	1,573
Season Totals									2,371,151	2,224,924	1,253,155	2,168,430

TABLE XI

DAILY CATCH OF PINK SALMON, 1971-1973-1975-1977 FROM CANADIAN CONVENTION WATERS

Date	JULY				AUGUST				SEPTEMBER			
	1971	1973	1975	1977	1971	1973	1975	1977	1971	1973	1975	1977
1	Strike				6,406	3,396		12,490	6,913	167,083	33,756	50,134
2	June 26-				5,243	3,452		5,713	15,269	157,615	61,793	
3	July 10				5,988				27,028	157,578		
4		1		75			470		13,692			
5	1						199		13,768		78,851	30,598
6		Strike				24,136		1,433	33,997		74,730	108,270
7		July 6-	50			14,643		23,843			50,627	
8	1	July 15				13,373		20,702	141,120		58,485	69,472
9			11		20,059	2,572	186	24,390	81,037	39,434		
10					17,280	1,481	70	693	86,916	50,859		
11	3				15,145		165		58,168	36,599		
12	5						121		46,851	27,396		28,051
13				172		23,520			31,098			1,279
14			18			24,987			34,631		62,355	44,759
15	20	40				38,368		207,768	26,718		45,604	
16		90			16,750			116,168			33,961	
17		84			9,010					58,070	29,163	
18		59					6,347			12,299	58,966	
19	31						11,200			7,441		548
20	51			173		79,374	9,559		14,866			126
21			243	152		71,878	14,836		7,649			9,285
22			130		23,135	125,369	9,634	37,831	172,256		45,221	
23		7,155			25,979	10,591		136,178	27,182		2,800	
24		5,601			17,141			55,838		31,267		
25		4,415	Strike	4,633			96,884			1,191	10,910	
26	192		July 25-	120	73,040		85,765		47,551	34,996	14,358	
27	57		Aug. 24		90,929	178,434	94,303		8,392			
28	217		712			131,738			1,299			
29			382			28,293		3,685	29,454		11,317	
30		2,963			224,988				17,488		508	
31		3,472			145,573			87,617				
Totals	578	23,880	1,546	5,325	696,666	775,605	329,739	734,349	943,343	781,828	659,047	342,522
Troll	41,634	93,200	72,114	274,529	245,984	248,042	56,040	604,639	121,281	52,393	99,598	45,067
Spring Salmon Gill Nets									16,822	7,305	14,358	3,527
Monthly Totals	42,212	117,080	73,660	279,854	942,650	1,023,647	385,779	1,338,988	1,081,446	841,526	773,003	391,116
June and Oct. Totals									71,029	78,426	23,448	65,520
Season Totals									2,137,337	2,060,679	1,255,890	2,075,478

TABLE XII

SUMMARY OF THE PINK SALMON ESCAPEMENT TO THE FRASER RIVER SPAWNING AREAS

District and Streams	*1977 Period of Peak Spawning*	*Estimated Number of Pink Salmon*			
		1971	**1973**	**1975**	**1977**
EARLY RUNS					
LOWER FRASER					
Main Fraser	Oct. 1-8	928,046	766,053	315,049	775,016
HARRISON					
Chehalis River	Oct. 8-12	32,178	14,300	2,356	2,613
FRASER CANYON					
Coquihalla River	Oct. 1-5	16,778	11,994	5,933	2,821
Jones Creek	Sept. 30-Oct. 7	1,304	2,544	2,645	3,350
Misc. Tributaries	Sept. 25-Oct. 7	4,498	3,699	974	3,687
SETON-ANDERSON					
Seton Creek	Oct. 11-17	262,534	179,691	209,734	341,256
Upper Seton Channel	Oct. 12-17	6,007	6,708	7,995	11,122
Lower Seton Channel	Oct. 7-10	24,882	23,602	23,874	37,163
Portage Creek	Oct. 3-6	1,456	13,983	28,454	19,904
Bridge River	Oct. 4-6	8,817	23,738	10,803	25,800
THOMPSON					
Thompson River and Tributaries	Oct. 3-10	257,388	283,385	477,644	972,941
TOTAL*		1,554,563	1,331,152	1,088,167	2,204,015
LATE RUNS					
HARRISON					
Harrison River	Oct. 8-15	73,881	196,150	180,052	126,782
Weaver Creek	Oct. 5-12	1,141	255	411	2,397
Weaver Channel	Oct. 5-12	294	640	1,201	963
CHILLIWACK-VEDDER					
Chilliwack-Vedder River	Oct. 14-18	160,511	210,799	81,137	48,561
Sweltzer Creek	Oct. 14-18	13,122	15,265	16,121	5,093
TOTAL*		250,389	423,109	278,922	183,796
GRAND TOTAL*		1,804,952	1,751,261	1,367,089	2,387,811

*Totals may include small numbers of fish in small tributaries not listed in the table.

COMMISSION PUBLICATIONS, 1978

1. Annual Report of the International Pacific Salmon Fisheries Commission for 1977.

2. Progress Report 38. Acute Toxicity at Annacis Island Primary Sewage Treatment Plant by J. A. Servizi, D. W. Martens and R. W. Gordon.

3. Progress Report 39. Effects of Selected Heavy Metals on Early Life of Sockeye and Pink Salmon by J. A. Servizi and D. W. Martens.

STAFF

A. C. Cooper, Director

NEW WESTMINSTER

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P. Cheng
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S. R. Killick, Chief, Operations Division
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E. B. Phillips, Administrative Officer
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SWELTZER CREEK LABORATORY

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H. J. Enzenhofer
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R. L. Johnson
S. G. MacLellan
D. W. Martens
K. Peters
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Dr. J.A. Servizi, Chief, Environment Conservation Division
E. R. Stewart
I. V. Williams, Chief, Biology Division

HELL'S GATE FISHWAYS — F. R. Johnston
UPPER PITT FIELD STATION — W. E. Keillor
WEAVER CREEK CHANNEL — C. W. Miller
GATES CREEK CHANNEL — V. E. Ewert
SETON CREEK CHANNELS — E. R. Pierce
CHILKO LAKE — F. G. Scott
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